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ABSTRACT

This proceeding includes the following 28 papers selected from the 1992 Conference of the Australian Society for Educational Technology: "Ecunet, Edith Cowan University's Video Conferencing Network: Two Years On" (Michael Grant); "Navigation Options in Interactive Multimedia" (John G. Hedberg & Barry Harper); "The Western Australian Networks for Learning Trial: Overcoming the Problems of Distance" (Geoff Rehn); "Introducing Computer Based Education" (Graham Huxham, Bev Oelrichs, & Eileen Beswick); "Learning Needs in Industry: Meeting the Challenge" (Rod Alford & Nev Pryor); "The Use of Advanced Learning Technologies in Health Sciences Education" (Allan Christie); "The Parliament Stack" (David Arnold & James Steele); "Supporting the Multimedia Courseware Author: An Introduction to the ACT-IT Project" (Brian Inwood); "Interactive Audio and CALL on the Macintosh" (Geoff Rehn); "Developing Evaluation and Design Methodologies for Multimedia Based Learning" (Leonard L. Webster); "The Core Safety Training Project: A Networked, Multimedia, Competency Based Training Program" (James Burgess & Greg Colgrave); "Issues in the Development of Multimedia Courseware" (Patricia Youngblood); "Yes, I Did Do It On Repurpose!" (Stephen Michael Barnett); "Interface-Lift: Elective or Compulsory?" (Susan E. Metros); "An Incremental-Transfer Approach to Instructional Design" (P. R. Wallace); "Telecommunications Impacts on Interactive Multimedia" (M. J. Biggar & C. J. Scott); "The Interactive CD--Learning and/or Entertainment?" (Lesley Richardson & Tom Duncan); "The National Educational Communications Framework: Analysing the Question of Common Technical Specifications" (Roger Atkinson); "Considering the Human Factor in Open Learning: The Police Experience" (Karl J. O'Callaghan); "Desk Top Publishing: A Case Study" (Clare McBeath); "Developing Style for Multi-Institutional Distance Education Course Development Projects" (Neale Kemp, Fons Nouwens, & Steve Towers); "Global Aspects of Resource Sharing: The Library's Vital Role of Information Transmission) Shih-Hsion Huang; "Identification of Suitable Distance Education Technologies in the Anangu Teacher Education Program" (Rigmor George); "Using Desktop Publishing To Produce Educational Materials: Hardware and Software Issues" (Robert Goodwin); "The View from "Clever City": Looking at Australian Education Through Promotional Videotapes" (Ian Hart); "The Distance Education Learner and Educational Technology" (Ernst Hintz); and "Open Learning and Telecourses: The Role of Television in Adult Education in Australia" (Grahame Ramsay). Most of the papers contain reference. (TMK)

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Educational Technology for the Clever Country

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Ecunet, Edith Cowan University's Video Conferencing Network: Two years on

Michael Grant
Edith Cowan University

In 1989, Edith Cowan University applied for and was granted $550,000 through the DEET National Priorities Reserve Funding scheme to install a video conferencing network. Work commenced in January 1990 on final planning and technical design with Telecom Western Australia. Contracts were finally signed later that year and the network was commissioned in July 1991 for a first stage of operation. One year later, and some 500 hours of transmission time later, the network is proving to be a major success with the very real possibility of needing to enlarge its transmission capacity during 1993. The original plan was to create a narrowcast network linking the University's four major campuses. However its network architecture, using Telecom's Television Operating Centre in Perth as its hub, has enabled the University to access other networks and it has played a major role in two state projects bringing live interactive video instruction to non metropolitan areas of the State. Utilising its fibre optic links, both full bandwidth analogue signals and digitally compressed video signals have been sent by satellite to learning centres, colleges and Aboriginal communities in outlying areas. This paper presents an overall view from planning stage to operational management, highlighting achievements and detailing areas which will demand further exploration.

The video network currently operating at Edith Cowan University was conceived in 1986, but it was not until December 1989 that it attracted funding through the DEET National Priorities Reserve Funding Scheme when a sum of $550,000 was allocated to install the system.

Two previous scenarios had suggested the use of Telecom's leased bearers along coaxial cable, or alternatively a University owned microwave network linking the three major metropolitan campuses with a leased bearer to connect the fourth campus at Bunbury.

However, early in 1989 Telecom engineers suggested the use of optical fibre cable, a system previously ruled out because there had been no predictions that optical fibre would have been available at that time. Optical fibre enabled Edith Cowan to develop a network that quite specifically would meet its requirements.

The need for a video network stemmed from the multi campus nature of the University. It was becoming increasingly common for some staff to find themselves lecturing on more than one campus, often giving the same lecture to a new group of students. This resulted in excessive travelling commitments particularly to Bunbury which involved approximately an overall five hours of driving time. It was also difficult to offer specialist courses on some of the smaller campuses where intake and class numbers were too small to make running the course viable. This was particularly so at Bunbury.

Added to the problems faced by lecturers, administrative meetings in multi-campus situations are notorious for eating up time, and it was generally felt that the network would alleviate some of the problems faced by the administration.

Design Specifications

University and Telecom staff designed the network according to the following specifications:

1 The four major campuses of the University had to be linked.

2 The video link should be both ways, so that a full degree of interactivity could be achieved in both sound and vision.

3 The quality of the signal should be of the highest standard achievable which happened to be full bandwidth giving domestic television quality. The reason for this was the intention to make the operation of the network as transparent as possible — that is, neither student or lecturers should be distracted by poor quality, vision or sound.

4 That the system should be used primarily for telelecturing, with administrative video conferencing in second place. In other systems around Australia, video conferencing was the prime user. This specification has an impact on possible sites on campus that were to become 'interactive'.

5 That whilst the network operated on a narrow cast system, nevertheless there would be a need for flexibility in going outside the network to other networks. This might be in a broadcast mode via the Golden West Network, OTC or AUSSAT.

6 Whilst the system would be analogue based, nevertheless there would be a need to access compressed digital networks. Therefore a gateway to such systems must be devised in the architecture of the network.

7 Control of the network and its operational management ideally should be centred at one of the University campuses.

8 The network had to be capable of expansion.

It would be true to say that all eight specifications have been complied with and the network is proving to be amazingly flexible.

Expectations

Expectations of the developers:

1 To provide increased access for students to courses that without the network might not be available on certain campuses. This relates particularly to Bunbury.

2 To provide access to specialist teachers and lecturers.

3 To achieve a decrease in staff travel between campuses to deliver the same lectures.

4 To create viable groups of students so that courses can run.

5 To offer the possibilities of reticulation of video and film material between campuses.

6 To provide telecommunication services to the University's outreach program and to extend the possibility of delivering courses by the use of the technology to the developing Learning Network in the State.

The 'necessary' and desirable innovative components of the network

Necessary

1 The network should be as 'transparent' as possible. This means for the student, clear and positive technical reception without noise, and in the interactive mode the ability to 'contact' the lecturer in question comment or answer without difficulty. In fact, to as near as possible to replicate the situation as if the student and lecturer were within the same room. Thus the decision to provide full bandwidth television to contrast to compressed signals was a deliberate effort to achieve the highest level of 'transparency'.

2 From the lecturers point of view, the network should be user friendly — that is it should not require increased technical skills to undertake telelecturing. It should be as 'transparent' to lecturing staff as it is to students.

3 Interactivity should be achievable from a variety of venues on each campus. Currently these extend to a large lecture theatre, a smaller lecturer theatre or tutorial room, a conference room, and at Mount Lawley and Churchlands to the television studios. This enables a variety of group use.

4 The network should not rely on a manpower heavy operation, as this would contribute unfavourable to the cost. Currently the network has two full time staff with assistance given by other media staff on each campus in the course of their other duties.

Desirable

1 Currently the network is capable of accepting one transmission at a time except in certain configurations. For example, Churchlands to Bunbury and Mount Lawley to Joondalup provides for two links at any one time.

However, Churchlands to Bunbury, Joondalup to Bunbury would not currently be possible. It would be desirable if the system could be multiplexed: that is for multiple signals to be sent down the fibre. This is technically possible, but the equipment is both very new and expensive. It is expected that this possibility will become technically and financially feasible in one to two years.

2 On certain campuses, there is already a need for a specialist conference room. The current conference rooms at Churchlands and Mount Lawley are not ideal for this purpose.

3 The need for a third member of the network team will emerge in the near future as the current usage grows.

Technical Details

The network provides a both way full bandwidth analogue video network linking the three major metropolitan campuses of Churchlands, Mount Lawley and Joondalup by fibre optic tails drawn to the nearest telephone exchanges, and thence to Telecom's Television Operating Centre (TOC). The Bunbury Institute is similarly linked to the Bunbury Telecom exchange with the use of itinerant leased bearers to TOC. Through a switching system (CITS) in TOC and operated at Churchlands, full bandwidth interactive video can be transmitted between campuses, to provide live lectures, the down loading of already recorded material and a variety of other uses. The system provides both way signals, although the preferred mode may be one way video and two way audio, on the grounds of the increased costs related to both way transmission.

Entry to digital compression networks can be achieved through a codec gateway in TOC Perth via a Rembrandt two codec. If there is a need to gain access to Picturetel systems, because, for instance, of the failure of H261 to achieve compatibility, the University will either interface a Picturetel codec within its network or negotiate with Telecom to provide a Picturetel gateway in its' own system architecture.

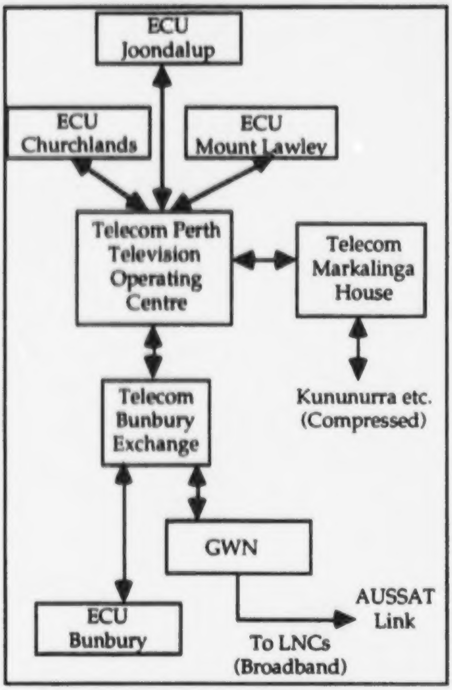

ECU Joondalup
ECU Churchlands
ECU Mount Lawley
Telecom Perth Television Operating Centre
Telecom Markalinga House
Kununurra etc. (Compressed)
Telecom Bunbury Exchange
GWN
AUSSAT Link
ECU Bunbury
To LNCs (Broadband)

Figure 1: ECUNET Configurations (After B G Pilcher, 16/3/92)

The ECUNET architecture allows not only the narrowcast capability between the four university campuses but also to a point to multipoint mode via the Golden West Network in Bunbury. Currently, uplinking is to a 12 watt transponder for the WESTLINK project, or for the WA Higher Learning Networks project, and for live broadcasts via the RCTS EDTV channel, broadcasting during the four school terms.

Ecunet Locations

A number of areas have been identified on each campus to provide full interactivity, although all lecture rooms and theatres are capable of receiving a one way signal via the CCTV networks, making up over 300 outlets. Those areas capable of full interactive transmission are on each site.

- a large lecture theatre
- a smaller lecture room
- a conference room

Other special areas are:

- Two television studios (Churchlands/Mount Lawley)
- One room capable of taking a small tutorial group (Churchlands)
- One Graduate Management Centre (Churchlands)

Total — 16 fully interactive areas all with fully installed equipment.

Future Plans:

- A new video conferencing centre at Joondalup (1994)
- Microwave system fitted to an Outside Broadcast van (1993)
- Links to Claremont campus, and the new Conference Centre (1993/4)

Highlights—1991

A series of ten lectures on new information technologies broadcast from the Mount Lawley studio live via the Golden West Network to all non metropolitan areas of the state — a co-operative venture between the University's Media Studies Department and the Media Services Division. An 008 phone number allowed viewers to phone in with questions to the lecturer.

A television transmission to Noonkenbah Aboriginal Community. One way video and two way audio from Mount Lawley campus studio. Wives and children from the community who were in Perth to attend a conference spoke with members of the community in Noonkenbah.

Highlights—1992

A UNE (Orange campus) ECU (Bunbury campus) live both way tutorial given to 10 UNE students in Bunbury.

A live broadcast via a 12 watt transponder to the rest of the state of a lecture given by Professor Odille Challe from the University of Paris, Dauphine from the Mount Lawley Campus lecture theatre, which incorporated live pictures of mini-tel, the French telematics system which were accessed and operated from the lecture theatre by Professor Challe.

One hundred and sixty four hours of narrow cast via the Westlink projects 12 watt transponder to Broome, Derby, Kununurra, Esperance, Narrogin, Geraldton one way video two way audio, and 50 hours of compressed transmission to Kununurra. Topics included computer studies, nursing, professional development.

A video conference linking 33 Aboriginal communities in Western Australia with Aboriginal groups and individuals from the Mount Lawley Conference Room — Perth.

Recommendations arising out of the project:

1 There needs to be considerable thought given to the reasons for establishing video conferencing, avoiding, as Castro 1989 puts it, video conferencing becoming 'a solution looking for a cause'. Curtis, in *Communication News* June 1992, emphasises the need to be concerned more with educational quality than with how point A connects with point B.

> The issue is not to define the transmission medium; the issue is to define the learning objective. You have to know the style, the communication capacity and skills of the instructor. You have to know who the students are, what they already know and their learning styles. You have to know the nature of the message, its information intensiveness and the learning objective. Once you know all these you can figure out what kind of channel you need. Until you know all those things you are going about it the wrong way if you start with the channel and work back.

2 Selection of potential systems without giving much thought to the points made by Curtis, has led to false expectations and feelings that the system won't perform. An example might be the selection of compressed video systems operating on 128kb per second because 'its cheaper' rather than will it be successful in carrying the sort of messages it will be required to carry.

Thus, tests carried out at CSU Chico, demonstrated that compressed video is not adequate for a generation of students who have grown up with broadcast quality images. On the other hand, in certain circumstances where broadcast quality image may not be achievable, a compressed signal may be better than no video signal at all.

3 Thought has to be given to venues, and their adequacy to perform tasks set for them. For instance, it is economical to transmit a lecture being given to a large audience at the transmitting end. Some video conference facilities cannot deal with such a large group exercise and may be confined to a maximum seating capacity of ten to fifteen bodies. Again a preliminary analysis of need might have revealed a problem.

4 Methods of funding have to be carefully examined. Should Faculties or Departments be expected to pay for transmission costs etc. from day one or should some funding be allocated centrally in order to help this innovative mode of teaching to become firmly established?

5 Care has to be taken on how video conferencing or telelecturing is sold to staff members. Insecurities abound, and some lecturers may feel that their services may not be required if this methodology grows. Such questions as 'should sessions be recorded for future use' and 'I now lecture to 400 students instead of 100 — shouldn't I get paid more?' will be asked. (In our case they already have been asked!) Should lecturers expect to be paid more money to 'perform' in such a manner? What about copyright?

6 It may be very valuable to set up a users committee representing Faculties or Departments. such a committee can brake decisions on ethical cases, perhaps even provide pressure when extra funding might be needed.

Conclusions

There can be little doubt that video conferencing is a very successful way of communicating information which needs to have a person interface (in contrast to the passing of data between parties via a computer screen). In a teaching situation there are few subjects that could not be taught both effectively and efficiently. In the first year of operation of the Edith Cowan Network the following subjects have been successfully taught.

Nursing — Particularly professional development courses

Business Studies — Accounting and Law

Media Studies

Justice Studies

Education — Particularly professional development short courses.

Computer Studies — Linked also to interactive computer operation and dialogue

Library Studies

Mathematics

We believe also that studies such as languages and art would all be suited to the methodology. Added to this administrative and other uses have included:

Heads of Departments and Faculty meetings

Interviews

Staff inservice

Union meetings

Careers guidance

Down loading video programs

Transmission of film between campuses allowing for use in non violation of copyright laws.

However, certain factors have emerged which demand further study and observation. Quality of reception is an important factor, and one which cannot and should not be dismissed lightly on the grounds of cost. ECUNET uses optical fibre so that it could proceed with its already existing campus based analogue CCTV systems. Quality of signal was always the primary concern of those planning the network on the grounds that if lectures were to be transmitted at the shortest distance of 15kms, a high degree of transparency had to be present. Students should not be affected by 'noise' as an added factor of difference. It was felt that until digitised signals became equivalent to broadcast standard, they would not be used between campuses. However, when contact had to be made outside ECUNET to areas in the state that had codecs, then the system had to be capable of accessing them.

The choice made, seems to have been endorsed by Terry Curtis whose Department of Communication Design at California State University at Chicago ran tests last year and this year to test the acceptability of compressed video conferencing. The tests demonstrated that at school level, compressed video is not adequate for a generation of students who have grown up with broadcast quality images. As Curtis comments:

> High school students and even College students are very uncomfortable with compressed video. ...Two way full motion video with low intensity information is wasteful. But if you have very information — intensive objectives, then anything less than two way full motion video is inadequate.

It would seem that in some networks developed in Australian Tertiary Institutions, an obsessive view has been taken that cost is the only factor to be taken into account, and that 128kbs is quite sufficient to get the message across. I have very serious doubts that this is a valid argument. What should be far more important is educational quality and not 'how cheap can we make it from point A to point B'.

There is perhaps a difference to be drawn between what we at Edith Cowan University have called 'tele-lecturing' and 'video conferencing'. For the former, quality of signal is a very important factor. For video conferencing which encompasses many administrative and small group functions, quality of signal may not be a paramount factor. Thus, if I want to talk to two heads of departments, I may find it acceptable to use a degraded signal in order to reduce transmission costs.

Similarly, there are times when one way video with two way audio is an effective mode of communication. This is particularly so when the purpose is to get the message to several dispersed groups — often called a point to multi point transmission. This method has been used very effectively in Western Australia to teach groups in country centres. One particular series has taught computer studies to five centres simultaneously, from Kununurra in the far North of the State to Narrogin in the South West. Use was made of a 12 watt transponder, and our full bandwidth signal was uplinked from GWN's earth station at Bunbury, meaning that all centres received a quality signal very necessary when explaining the intricacies of a computer screen! It is difficult at this time to provide an accurate estimate of the cost-saving and indeed the time scale that would have been involved if our computer expert had been providing the on-site teaching for each centre. If it had been possible it would have cost many thousands of dollars.

Another question that needs examination is the organisation and management of a network. It would seem from our own experience that once a network proves accessible and successful, there is an exponential growth of usage. Much care and attention was given to the location of network sites on each campus. Currently sixteen sites are fitted out on the four University campuses, providing alternative and varied locations. These range from a large lecture theatre, a small lecture room, and a conference room on each site, together with specialist areas like TV studios, a Graduate Management Centre and a small video conference room totally dedicated to the network. Programming becomes a vital component in management, particularly when locations are not dedicated to the network. Outside links also have to be booked with Telecom or any other agency involved in the conference. Two staff members ran the network at ECU with assistance from other Media Services staff on campuses. However, it is acknowledged that staff levels have to be kept at a minimum which has led to plans for ease of operation and remote servicing wherever possible.

Following London University's 'LIVENET' a user group was formed from representatives from each Faculty in the University. The purpose of this group was to take responsibility for University access and future growth, determining questions that might arise as use expanded. Media Services would be left in operational control only.

Other questions that will soon have to be answered relate to codec compatibility, multiplexing, and sound quality in certain modes of operation. Currently two makes of codec have been selected by Universities and TAFE colleges neither of which can 'talk' to the other. The advent of the international standard H261 will reputedly clear this problem, although it is by no means certain that full compatibility will be achieved. In the meantime a national network is at risk because purchase commitments have been made on insufficient evidence that equipment will perform in the manner in which it is meant to perform.

Multiplexing means transmitting more than one video signal utilising an original source. New technology developed by CLI, the spectrumsaver broadcast video system using compressed digital video (CDV) will allow up to a dozen or more channels to be broadcast over a satellite transponder. The system currently being installed at the Monterey Institute of Technology in Mexico requires only 2.3mhz per signal of the 36mhz bandwidth available on the satellite transponder, and delivers excellent pictures. Whilst this may not be a preferred solution for Australian networks, nevertheless it does mean that there are several alternatives already available which should be examined before commitments are made to systems requiring multiple signal transmissions.

Associate Professor Michael Grant is Head, Media Services Division at the Edith Cowan University. He is currently a board member of Radio Station 6NR, on the Advisory Board of the School of Communications and Cultural Studies at Curtin University, a member of the Media Advisory Board, Academy of Performing Arts. He is also a member of the Management Board of the Festival of Perth and Chairman of the Friends of the Festival of Perth. He has over the past two years, directed two DEET funded National Priorities Reserve Funding projects — the Cowan Video Conferencing Network and the Western Australian Distance Education Consortium Japanese Language Interactive Videodisc project. He can be contacted at the Media Services Division, Edith Cowan University, Pearson Street, Churchlands 6018, Western Australia

Navigation Options in Interactive Multimedia

John G Hedberg and Barry Harper
University of Wollongong

Navigation is a unique problem for the interactive multimedia environment — the user must browse information often with a number of options and choices. These options are cued by a number of different devices. Navigation can take a series of forms: It can allow increased learner control, by indicating learning options; it can provide a physical model of either the learning sequence or the layout of the information; or it can be adapted to meet the learner's requirements and even allow the user to specify the relationships he or she wishes for the information. Information in a multimedia environment can include any form of representation, text, graphic, picture, sound, animation or motion video. These options increase the difficulty in organising information by the learner. Faced with a multitude of possible choices, inputs and paths through information landscapes, a learner can easily become confused and a powerful vehicle for learning can become a time consuming problem. This paper reports on a study of the navigational demands of hierarchical, relational and sequential navigation systems in interactive multimedia learning materials and discusses the instructional design implications for learner generated and instructor generated interactive multimedia materials.

Background

Considerable interest in the educational efficacy of the application of interactive multimedia resources for learning has developed as the use of this technology has emerged. A number of interactive multimedia simulation packages have been developed to incorporate high quality visual materials in the form of graphics, pictures, sound, animation or motion video. Some of the packages are prototypes and we are now starting to see some commercial products produced and released on the market. This major growth in the application and use of interactive multimedia resources for learning has occurred through changes in information technology software and hardware which allow the integration of multiple sources of information to be linked and presented together (Ambron & Hooper, 1990). This development has occurred coincidentally with the proliferation of sophisticated software authoring tools, which have not only given educators greater access to the production and design of learning packages but also enabled information to be structured in new ways which allow the simulation of a greater variety of learning models (Hedberg & Harper, 1992).

This rapid technological development necessitates a closer examination of the ways in which information is accessed and the concept of an information landscape has been introduced into the literature to indicate that this information can be represented and retrieved in a number of ways and in a variety of forms. It has allowed new and more complex instructional strategies to be employed in instructional software which offer the potential of more efficient and effective learning. While these learning strategies can be controlled by the learner and can employ a variety of cognitive modelling opportunities to facilitate learning (Hedberg, 1989), research on the efficacy on the variety of information access systems is lagging behind the technological developments.

With interactive multimedia the potential to shift the control of learning from the instructor, either as the teacher or through computer control and management, to the learner has been an important theme for many authors. Bork (1991) has supported the use of the media for student-centred applications as opposed to administrative–centred or teacher–centred applications with this form of learning strategy a recurring theme throughout modern pre-tertiary curriculum documents. Current technologies facilitate the use of such materials by individuals and small groups and challenge instructional designers to develop educational systems to take full advantage of the interactivity not simply in terms of user control but to enable users to actively chose their learning strategy.

As the use of this technology has developed the concept of user control has become an important and essential issue. There needs to be consideration of how much user control over learning strategies is the most efficient. Hedberg and Perry (1985) have proposed that used effectively, the technology can allow users to interact in ways that the designers of the system did not plan and that good instructional design of interactive multimedia materials makes it unnecessary for materials to be structured for the learner. Effective student use of unstructured materials however, will depend on the type of access to the information the user can obtain, that is, the navigation options available to the user.

Navigation Systems and Learning

There are a number of problems with the existing research on navigation systems, these include:

a the need to investigate the cognitive demands of different navigation systems in interactive multimedia learning materials

b the extent to which current interactive multimedia design models address the issue of navigation

c the importance of navigation in achieving improved learning outcomes and .

d the efficiency of navigation systems in giving control to the learner.

An understanding of the theoretical issues raised by navigation systems can support the growing development of intelligent interactive teaching environments. The complex integration now possible with this variety of hardware and software combinations raises problems for the user in that multiple paths are possible to the same or different–end points. Learners are faced with the problem of understanding what learning possibilities might be available from where they are in a multimedia learning environment. When a student can branch down multiple paths and rapidly change the direction and focus of the learning sequence, there is possible interference with effective learning through the inappropriate application of information by the learner to their internal schemas.

Navigation Options

Navigation systems can facilitate the understanding of a students learning sequence and reduce the problems of poor learning schema development. A number of approaches have been discussed in the literature, such as the Guide metaphor where a character is created and used by the author to link ideas and visual travel through the hypermedia materials (Oren et al, 1990). Other suggested structures include those which are based on ideas such as sequential navigation (using cues to show how far you are along a path; the clues varying from a simple screen number of the total or some conceptual description of the sequence), visual navigation (using a plan of the possible paths), and hybrid navigation (mixtures of both) (Hedberg & Harper, 1991).

Using the computer to model the knowledge base and to give the learner the freedom to interact with it gives autonomy back to the learner. Rather than give the learner a set of pre-designed learning sequences that assume some learning model, a more interactive approach could be developed by giving the user an information landscape and the tools necessary to explore and investigate the information. The change in locus of control from instructor to learner raises a series of hypermedia issues about cognition, motivation and navigation which need to be explored (Grabowski & Curtis, 1991) and the outcomes applied to the current navigation systems. This is where the level of flexibility and adaptive nature of the navigation system is important.

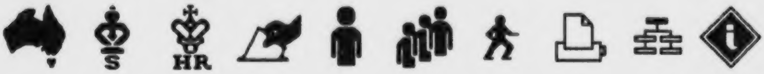
Package designers have used a variety of techniques in screen design to present navigation cues for users. They include:-

- using colour to identify the area or major learning path,
- the positioning of the element in the screen to indicate the place in relationship to the underlying metaphor (in this case a simulated lake) or the separation of positional navigation choices from the functional options (for example, separation of the movement from help and explanation functions)
- simple use of contextual clues, regular use of a standard format of basic word style format to indicate links with other sources of information.
- written directions which appear in separate areas or windows to the information required to learn the underlying concepts.
- simplified mnemonics or preferably the use of icons to provide standard and immediately comprehensible support for navigation or learning.
- the development of search strategies and links to metaphorical maps which encapsulate learning path choices.
- enabling learning path maps to be modified highlighting the paths which have been travelled.
- creating new links by the learner using a series of tools which enable the package to be modified, either by adding new information or by adding new hypertext linkages based on the students own conceptual maps.

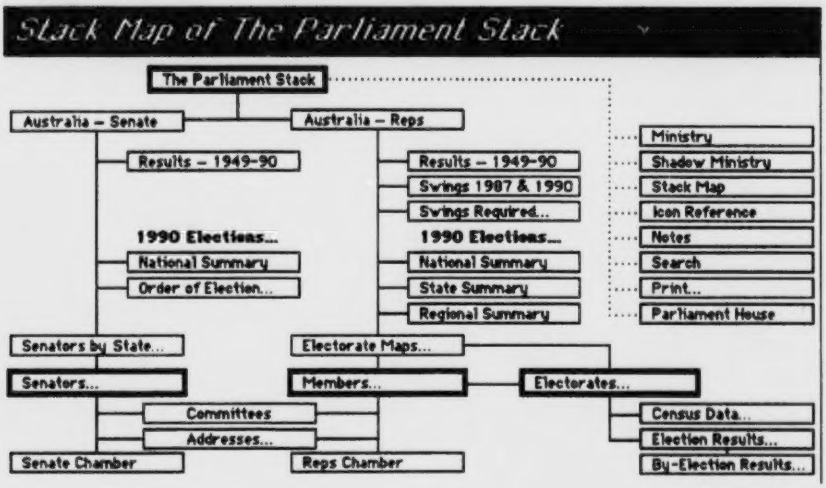
Defining Navigation Types

Research into the area of Cognitive Load Theory (Sweller, 1988) has demonstrated that materials can be designed to focus on the appropriate development of schema and hence improve learning efficiency. In effect any navigational system must employ elements with as much intrinsic meaning as possible. However, creating this link between action and meaning may not be as intuitive as designers sometimes assume, but this link can be enhanced through understandable and well chosen metaphors. Together with the growing emphasis on Constructivist approaches to the design of multimedia learning experiences, an alternative theoretical basis for considering the problem of navigation can be constructed. Navigation systems exemplify the following representational forms:

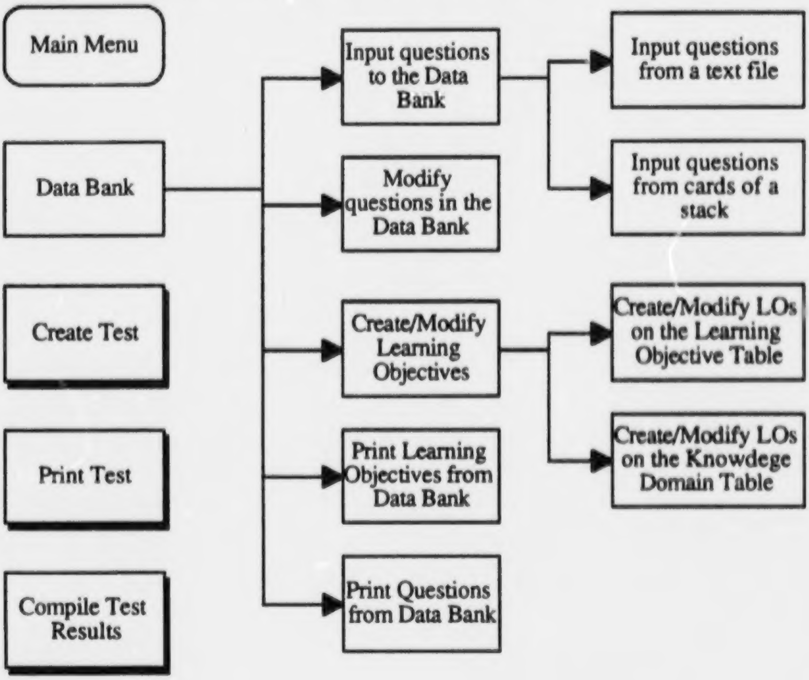
> **Modal** — selection of either graphic or text to carry most meaning and be the governing way information is presented. If the user has a preference of either form of navigation, should this be available, or should one consistent mode be available to the user? The following icons from the Parliament Stack represent a purely graphic mode of navigation.



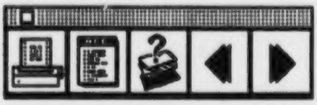
> **Relational** — how elements relate through objects such as stack maps. Stack maps are graphic representations of the information outline showing key nodes or decision points. When used, it should be ever present and accessible from all parts of the materials. A number of interactive multimedia packages make efficient and effective use of this navigation tool. The great advantage for the user is the availability of rapid access to location in the information landscape by cutting across the conceptual forms of representation of the information. The following example is again from the Parliament Stack.


Stack Map of The Parliament Stack
The Parliament Stack
Australia – Senate
Australia – Reps
Results – 1949-90
Results – 1949-90
Swings 1987 & 1990
Swings Required...
1990 Elections...
1990 Elections...
National Summary
Order of Election...
National Summary
State Summary
Regional Summary
Ministry
Shadow Ministry
Stack Map
Icon Reference
Notes
Search
Print...
Parliament House
Senators by State...
Electorate Maps...
Senators...
Members...
Electorates...
Committees
Addresses...
Senate Chamber
Reps Chamber
Census Data...
Election Results...
By-Election Results...

Hierarchical — moving through the content in terms of main idea to minor idea or visually clicking to see what is a small component of the larger. Most information has a subdivided or categorised structure. Each element of this structure of the information metaphor should be able to be used in conjunction with navigation around the overall metaphor or information environment. The information structure is often chunked to allow the hierarchical classification or structuring of the information to be accessible level by level as the detail is revealed. This type of navigation form is often strongly associated with a metaphor to represent the information and then what might be called sub-metaphors or maintenance of the metaphor is used to continue the analogy of the metaphor to more detailed information levels. This type of hierarchical information access maintains the overall metaphor of the information landscape, and yet can also allows the designer to represent the more detailed information in a variety of forms such as textual, video or audio format rather than maintaining the higher level metaphor. A simple hierarchical menu structure is shown below.

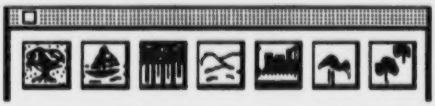

Main Menu
Data Bank
Create Test
Print Test
Compile Test Results
Input questions to the Data Bank
Modify questions in the Data Bank
Create/Modify Learning Objectives
Print Learning Objectives from Data Bank
Print Questions from Data Bank
Input questions from a text file
Input questions from cards of a stack
Create/Modify LOs on the Learning Objective Table
Create/Modify LOs on the Knowdege Domain Table

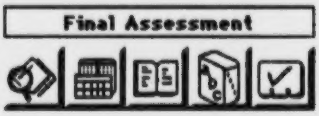
Sequential — moving through a database one card at a time either forward or backward. This type of navigation tends to be most appropriate at the lowest level information level or chunk and also is most appropriate when common elements need to be accessed. The following palette represents such a simple sequential structure.



Geographical/Spatial — selecting parts of a whole by an inherent physical/geographic relationship. This approach might be exemplified region by using a map as the link between objects.

Conceptual — choosing between different key conceptual representations of the information landscape. Information access of a larger contextual nature can be embedded in learning packages in a variety of forms. The metaphor concept is commonly used for this type of information organisation system. There have been some quite good examples of this type of navigation implemented in current commercial packages(McCormick, 1987). The following two examples are for an ecology simulation and a series of learning tools in an instructional sequence.





A number of representational forms can be used for navigation which have the potential to allow greater user control of information landscapes. There are a variety of strategies that can be incorporated into these navigation systems, but we know little about the effectiveness of the claims for clarity of access and development of user-centred learning outcomes. These examples are drawn from a current research program that is investigating the range of navigation processes that can be applied to interactive multimedia.

Conclusion

In this paper we have focussed upon the research issues associated with the design and provision of effective, and intuitive navigation systems and the importance of conceptual clarity in the quest for knowledge using navigation systems. The change in locus of control from instructor to learner raises a series of hypermedia issues about cognition, motivation and navigation which need to be explored (Grabowski & Curtis, 1991). The variety of options available to instructional designers now need to be evaluated in the light of the various instructional paradigms so that clear guidelines for developers can be determined and made available. Only with detailed information about the user perceptions and use of navigation systems for interactive multimedia packages can we hope to effectively master the technology for improved learning outcomes.

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The Western Australian networks for learning trial: Overcoming the Problems of Distance

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In this paper, the author discusses the various technologies that he has used in participating in the above trial for the first six months of 1992. These technologies include one-way video conferencing, the use of telematics / audiographics and the use of e-mail. Discussed is the process of media integration that evolved in adapting teaching strategies to the new delivery mechanisms. Of special interest have been the experiments in transmitting the Macintosh computer screen via satellite to remote locations, thus enabling the presentation of classes in computer literacy to students with no prior experience of computing. Briefly discussed are some of the difficulties attendant with the establishment of such a learning network, as well as some of the technical problems that are still in the process of solution.

The Networks for Learning trial has received further funding for another year. This paper, along with the presentation to be given at the conference, will provide useful advice and techniques to those parties intending to use similar technologies in the provision of interactive classes to remote students. The paper will be supported by a multimedia presentation outlining the work to date.

The Western Australian Office of Higher Education instituted the Networks for Learning trial towards the end of 1991, when three Network Learning Centres were established in the Kimberley region in the far north of this state. These centres were to be funded for a trial period of approximately six months only and, thus, it was critical that the venture prove itself viable in this short time. The Department of Aboriginal Programmes within Edith Cowan University indicated its willingness to become an active participant from the outset of the trial. This followed experiments and trials during the 1991 academic year that investigated alternative means of delivery to the remote student, including use of the University's two-way full-motion fibre optic links to Bunbury to deliver statistics classes, use of the two-way compressed video Iterra satellite link to Geraldton to deliver a computer literacy class and participation in the first use of the spare 12W AUSSAT transponder in linking with the remote Aboriginal community at Noonkanbah in the Kimberley, as well as a video conference linking Aboriginal students and staff at the Mount Lawley and Bunbury campuses of Edith Cowan University. Thus, very valuable experience was gained in the varied use of the medium, including the ELMO document presenter as well as an appreciation of the technical difficulties of transmitting a computer lesson via satellite.

Additional experience had been gained in the development of computer-based courseware using such software as AuthorWare Professional, HyperCard and HyperTeacher. However, due to the constraints of time and resources, these latter activities were not of significance during the trial except in the use of AuthorWare as a presentation medium during satellite delivery of lectures. Nevertheless, skills gained in the use of computer aided learning and effective screen design proved of value in the development and use of the audiographics / telematics software Electronic Classroom during the above trial period.

The Department of Aboriginal Programmes indicated at the end of 1991 that it would be in a position to offer three units of its Aboriginal University Orientation Course as part of the Networks for Learning trial. The Aboriginal University Orientation Course (AUOC) is currently a seven unit program of study designed to prepare Aboriginal adults for university. Thus, it was particularly fitting that a course, whose design and intent was to increase the access to higher education of a clearly identified disadvantaged group in the remote and rural areas of Western Australia, would participate in the trial.

Three units of study were to be presented using alternative means of delivery including telelecturing by satellite (video conferencing), telematics or audiographics, use of e-mail and computer mediated communication and facsimile. The three units were Foundations of Mathematics, Foundations of Statistics and Introduction to Computer Applications.

Before the beginning of the 1992 a rushed promotions campaign took place to advise of the availability of the above units to the remote centres at Kununurra, Broome and Derby. This was done by providing the recently appointed Learning Network Centre co-ordinators with publicity flyers and information on the above course. In addition, external students registered with the Department of Aboriginal Programmes, whose postal address included the above locations, were notified by mail of the plans for delivery of lectures in the above units via satellite.

In hindsight, the above process was not overly successful. Advising remote students of such new initiatives in such a fashion would do little to overcome the reluctance of many to participate in new modes of delivery, of which little information was available. Nevertheless, students from the above three centres, and later Narrogin in the Great Southern, actively participated in the trial.

A two-way video conference took place with Kununurra in mid-February before the commencement of the academic year to promote the course, Kununurra being the only centre with satellite receive facilities at the time. Only one Aboriginal person belatedly attended this early contact session and, consequently, an occasion for the positive promotion of the course may have been lost.

In early December 1991, a request was made to the Department of Media Services at Edith Cowan University to commence examining in detail the technical problems involved with satellite delivery of the Macintosh computer screen via satellite, to the remote centres. A visit at this time to the Distance Education Centre within the Western Australian Ministry of Education lead the author to appreciate the value of the audiographic software Electronic Classroom and an order for the package was placed, for the purpose of skills development and trialing.

Orders were placed for the necessary computer equipment to facilitate the trial, including a Macintosh QUADRA 700 which had the ability, with additional VRAM (video ram) on board, to provide the PAL composite signal necessary for satellite delivery. An application for additional seed-funding was placed with the Networks for Learning steering committee and seed funds of $4000 were provided by the WA Office of Higher Education

The Aboriginal University Orientation Course

The AUOC is a two stage course designed to increase the participation of Aboriginal people in a wide variety of higher education programs. The first stage is concerned with the development of literacy and numeracy skills of those whose early education was minimal. Stage two is concerned with the development and refinement of these skills, with a clear focus on higher education. AUOC is the only course of its type in Western Australia to be available in both the internal. on-campus mode and the external, off-campus mode. Only stage two of the course is available full-time in Perth, at the Mount Lawley campus of Edith Cowan University. This is significant in that the author would be required to present the above mentioned units of study to both his internal, on-campus students as well as to those remote students who were to participate in the trial.

An awareness of this requirement enabled the writer to book a suitable lecture venue at Mount Lawley that had video conferencing / satellite transmission facilities, as well as the necessary satellite time with the WestLink project at State Information Technology. Thus, the necessary bookings took place at the time of standard timetable arrangement towards the end of the 1991 academic year. Lectures in the units of mathematics and statistics would be given to the internal students in Perth and be beamed out to the remote learning centres. Thus, several units in Stage Two only of the AUOC would be part of the trial. There is certainly a need for use to be made of the new technologies in the meeting of the needs of less well prepared stage one students. However, this was not pursued.

Coming on-line

The academic year commenced at Edith Cowan University on Monday February 24. Lectures to the internal students at Mount Lawley commenced on this date. The first lecture in Mathematics took place on Tuesday February 25, with only Kununurra on-line with its two-way video facilities. The satellite receive facilities had not yet been put in place at any of the other centres. However, no students were in attendance at Kununurra, the enrolled students being Stage One only. However, the author's personal opinion is that had any students been in attendance at the initial classes, there may have been on-going interest and participation at Kununurra. In hindsight, the fact that two-way video was installed and operational at Kununurra may have lead any potentially interested Aboriginal students to shy away from the experience. To expect Aboriginal people to readily participate in a process that involves quite a degree of invasion of privacy, at such an early period of familiarisation with new technology was to expect too much. Despite an "open day" at Kununurra on February 28 whereby promotion from Perth of the AUOC program took place, transmissions to Kununurra in the units of Mathematics and Statistics discontinued after about three weeks into the semester, due to lack of students.

The author had intimated on many occasions previously the strong desirability for the lecturer to be known as a person before transmissions to the Aboriginal communities at the various centres took place. A request for a personal visit to the remote locations was not met. Human contacts with prospective students and promotion of the program and technologies might have produced a situation whereby more students would have participated throughout the trial.

The first links with Broome and Derby took place in the week beginning March 16, some four weeks after the internal, on-campus classes began. Students were present at both locations. However, no students continued at Broome in Mathematics and Statistics as they felt the course work was too difficult. It was a great shame that the satellite facilities at these two centres were not installed earlier by the commencement of the academic year as was intended. Any student who commences a course of study three or four weeks into a course is penalised, a remote student doubly so. Of course, the andragogic style used by the lecturer was such that those students who commenced at the beginning of the course would not be intimidated by the gradually unfolding content. Such benefit would not be felt by students coming into contact with content some four weeks old, especially in statistics.

So no students continued in Mathematics and Statistics at Broome. However, it is to the great credit of the students at Derby who continued throughout the courses and gave me much pleasure in their presence and interactions.

In early April, the learning network centre at Narrogin came on-line and participated in the mathematics classes. Despite the very late start, the Narrogin connection has been a successful and on-going one, with four or five students enrolled in the mathematics unit and intending to sit for examination.

Experiments in the satellite delivery of the computer screen were taking place from the outset of the academic year. This was a demanding process of technological innovation and perhaps it was well that the computers and other hardware and software did not arrive at any of the remote learning centres until late March. These developments will be traced in greater detail later when discussing the unit Introduction to Computer Applications.

Foundations of Mathematics and Foundations of Statistics

The unit QAI 0175 Foundations of Mathematics is concerned with basic mathematical literacy that will enable the intending non-specialist higher education student to approach elementary mathematical situations with confidence. It is also intended to meet the incoming numeracy skills of the education student at Edith Cowan University. The typical client group of Aboriginal adults have a very diverse range of mathematical experience ranging from some primary of many years back to recent Tertiary Entrance Examination (TEE) level exposure. The unit treats content from basic number work to rectangular Cartesian co-ordinates and graphing.

The unit QAI 0276 Foundations of Statistics looks at basic descriptive statistics from elementary graphing through to cumulative frequency graphs and the calculation of measures of central tendency and dispersion. As well, it contains a look at probability and the normal distribution occurs, as does an elementary study of relationship and causality. The focus throughout the unit is towards higher education, with constant reference to where the intending university student can expect to meet further statistics in his/her studies. The unit is unique in that the traditional emphasis in numeracy skills for accessing courses for Aboriginal people lies in basic mathematical skills, with little attention given to such necessary applied areas as statistics. The unit compares well with other units offered within Edith Cowan University that bridge into Statistics, as well it should. It is a personal view of the writer that intellectually challenging courses are appreciated by the Aboriginal student and that such students deserve the same, given that they will face the same demands as others when they enter higher education itself.

Evolution of Media Integration

The lectures were to be delivered using one-way video and two-way audio, enabling interaction from the remote sites. The first lecture was delivered in a very conventional sense with the white-board at the front of the lecture theatre in Perth serving as the presentation medium. Use of coloured erasable white-board markers enabled the usual development of a class in mathematics to proceed. The camera was required to pan over the length of the working space. The writer is / was inclined to spread his work out into the largest available working space. This presented some difficulties for the camera person in the projection / console room at the back of the lecture theatre. In the next lecture (in statistics), clear vertical boundary lines were first marked out on the white board, thus confining the work space.

This method of delivery is reasonably effective and provides a sense of "being there" in a very real way to the remote student. The lecturer can be seen and heard in the context of a whole classroom , as the material unfolds and there is an integration between the voice, the person of the lecturer and the content presented. However, it was difficult to ensure consistent professional quality of the presented work as white — board work is limited in its graphic capabilities. Besides, the continual panning and focussing by the camera person made his task the more difficult.

The next step was to use the standard over-head projector as the primary presentation medium, with the images focussed to the projection screen at the front of the theatre. This was more acceptable to the camera person, as the image projected is essentially a fixed one, not requiring the continual focussing of the camera. The use of broad thickness overhead pens of a variety of colours produced material of a very satisfactory and visually appealing kind. The camera person could set the camera at a fixed position and simply alternate between the projected image and the lecturer/presenter.

This in itself required an evolution of empathy between the camera person (Mr. Jerry Thompson from the Department of Media Services at Edith Cowan University) and the lecturer. In the lecturer theatre situation, as it currently is, the control of when to alternate between the vision of the lecturer and the projected screen image of the working-space lies with the camera person in the remote console box. In the early stages of the delivery of this unit, the lecturer was concerned that the image that was beaming out to the remote students was too dehumanised in that constant focus was on the projected mathematics. Protocol systems were thus developed whereby, say, the O/H pen placed on the O/H projector indicated to the camera person that the lecturer wished the camera to be focussed on himself, rather than the mathematics or the statistics. A growing personal empathy and an awareness of the lecturer's personal style as time went by obviated the need for such a formal mechanism of transfer of control. However, this area is still a problem (to the writer) in the lecture context. The problem does not arise in the video — conferencing format of, say, the computing classes where all control lies with the lecturer / presenter.

With the use of the O/H projector, despite the positive response of both internal and remote students, it was difficult to produce consistent quality work "on the fly", as the mathematics was worked for the students. O/H pen work is prone to smudging, especially when ruling lines and it was for this reason that the lecturer moved on to the consistent use of the ELMO video document presenter. Nevertheless, the O/H projector is an extremely powerful presentation medium when used well by the lecturer / presenter, especially in the use of prepared overheads with colour and suitable size of writing. The size and quality of the printing / writing is critical. If material is prepared using a computer word-processor with a suitable font and size such as 14 or 18 point Times, and overhead transparencies then made, the effectiveness cannot be faulted.

For each lecture in both Mathematics and Statistics, the students were presented with a statement of formal objectives for the lecture as well as a set of class exercises and review exercises. The class exercises would form the basis of the lecture presentation and the review exercises were for consolidation and use in the associated practice/tutorial session. These prepared materials were faxed out to the remote centres in the morning of the lecture. Some of this was done very much in keeping with the "just in time" philosophy of management!

The objectives for each lecture were increased to the above 14/18 point times and laid out as a suitable O/H transparency for presentation. This provided a suitable start and focus to the lecture, in keeping with instructional design principles that are consistent (in the author's opinion) with the learning of such disciplines as mathematics.

Experience had been gained in the effective use of the ELMO document presenter during the 1991 trials by the writer. However, the use of the document presenter does require that work be well-prepared beforehand. After several weeks, the various other administrative and logistic duties of the writer enabled sufficient time to explore the use of the ELMO video or document presenter further. Exercises were presented to the students using the document presenter. This requires that the work be confined to a 4 : 3 ratio rectangular A4 page for full focus of the ELMO presenter. For suitable legibility of the work, the writer experimented and chose to work with 3mm thickness calligraphic type pens of various colours. These provided a very effective graphic and text presentation tool of strong visual appeal.

It needs to be said that the image produced from the ELMO is projected to the front of the local lecture theatre at Edith Cowan University by an overhead video projector so that local internal students see what is done. The same image is also sent out by satellite to the remote centres. However, surprisingly enough, the quality of the transmitted image is better than the local image because of the resolution of the local installed overhead video projector.

Using the desk top publishing package PageMaker, the writer developed a standard 24cm by 18 cm template blank with black borders (with the necessary 4 : 3 ratio) that was used to provide a framework for the lecture exercises as they were done on the ELMO. This technique proved to be a very real boon to productivity and effectiveness. In addition, the lecture's objectives were laid-out using this same template and suitable 14 / 18 Times font.

The next stage in media integration was to prepare the exercises that the students received by pasting each exercise into one of the above 4 x 3 templates. The working out and solution of the exercise then proceeded with the exercise itself clearly shown at the top of the template. This was very sound practice.

It then occurred to the writer that the students themselves might value the set of prepared working sheets that were used, containing (large print) objectives and each exercise on a separate template page. Thus, a resource had been created for the student that would enable the student to concentrate solely on the task at hand and have a thorough record of the exercises and their solutions, as well as the objectives.

Such templates would also prove of value as blanks for the production of O/H transparencies for those involved in the support of the teaching of these units, such as remote tutors or contract staff who might teach the course at such centres as Karratha College, in the Pilbara region of this state. Also, the templates might form part of the remote tutor's arsenal of teaching aids, for photocopying and use while tutoring students.

Towards mid-semester, after technical problems with computer transmission via satellite had been solved, the writer developed computer-based AuthorWare Professional presentations of the objectives for each lecture class. These were then projected up to the front of the lecture theatre and beamed out via satellite. They included an Edith Cowan University logo, a scanned image of some Aboriginal students from Perth as well as a point-by-point run down of the objectives. Although offering little extra in the way of instructional design, this added a touch of finesse to the professional presentation of the lecture.

Also to be noted is that each transmission would begin with an attractive Edith Cowan University logo placed on the ELMO document presenter while the uplink to the satellite proceeded. Thus, unsightly images of pre-lecture activity within the lecture theatre were avoided and a professional start to each lecture could commence. As well, the audio link was muted. The major technical difficulty in the telelecturing was in the area of interactive audio. These concerns will be addresses briefly later.

Introduction to Computer Applications (Macintosh)

This unit within the Aboriginal University Orientation Course provides a general introduction to the use of an integrated software package, in word-processing, spreadsheet and data-bases modules and their integration. Internally, at the Mount Lawley campus, the unit has been based around Microsoft Works. However, a decision was made by the Networks for Learning Technology Sub-Committee to purchase the new ClarisWorks software package for use in the centres. The writer resisted this move as it implied even more learning required by him at a critical time, given that he was to be the person actually teaching the use of the computers to the remote students. However, the writer can report that the decision made was a very sound one and that the merits of ClarisWorks are many, not the least being its communications module which has been used by the centres in computer conferencing and e-mail, as well as ClarisWorks seamless integration across application modules.

The overcoming of the technical difficulties involved in transmitting the Macintosh computer screen, with its RGB video signal, out via satellite through the fibre optic system of Edith Cowan University, with the system's overall requirement of a PAL composite signal, was the source of the greatest personal satisfaction to the writer. There was a fair degree of scepticism by several parties as to the technical feasibility of such an achievement but it was done, with the collaboration and support of the Department of Media Services at Edith Cowan University. Foremost appreciation must be given to David O'Brien for his professional approach and perseverance in solving the difficulties, as well as Hugh Cleverly for his assistance.

Experiments are still progressing in the improvement of the quality of the transmitted signal but the current solution is the use of a NeoTech encoder that converts the RGB Macintosh signal to a PAL composite that can be transmitted out via satellite. Also, the Macintosh QUADRA is using extra VRAM (videoram) on board, with a total of two Mb. A NEC MultiSync monitor is used to monitor the signal that is output from the system, as the standard 13" Macintosh screen, using non-interlaced RGB, will not work with the NeoTech encoder. The quality of the computer screen image that is transmitted is good, with a little to-be-expected degradation, and this has enabled the conducting of computer classes to the remote centres to proceed.

As intimated earlier, it was well that the necessary computers and other hardware and software did not arrive at the LNCs until about mid to late March. In the mean time, trials were being conducted in the use of the NeoTech encoder and by early April, the video conferencing network was used in a very creative fashion to take the remote learning centre co-ordinators through the process of setting-up their local area computer networks (LANs). For interest, the LANs consist of a LC or a II CI running under System 7, with single drive Classics hanging off them, using System 6.0.7 start up disks. Thus, the networking capabilities of System 7 are employed and the host machines act essentially as file servers (although students use the host computers as well), with the ClarisWorks software installed on the hard disks.

Thus, the LANs were set up by early April and lessons in the above computer applications unit could begin. It needs to be stated that the writer spent not a small number of hours mastering the intricacies of System 7 and how to essentially administer a network — something that was unfamiliar. Thorough mastery was required as the writer would be taking students through a process that is difficult enough even in the usual face-to-face computer laboratory environment where the lecturer can see the student's screen and difficulties. In the situation of one-way video and two-way audio, the audio connection was to prove critical indeed.

Lessons in computer literacy began in the second week of April, with students at all centres, Kununurra, Broome and Derby. This involved straight front-on "talking -head" work, use of the ELMO document presenter for transmission of preliminary instructions and procedures and, of course, the Macintosh computer screen itself. This teaching proceeded in a video-conference type set-up, with no internal students to contend with. It is the writer's opinion that multi-pointing to so many locations and dealing simultaneously with local students would be difficult indeed and would require a change in learning methodology by local internal students.

Indeed, there would have to be a limit on the number of points that could engage effectively in interactive audio with the lecturer. however, such audio interaction is essential for the skills to be developed by the remote student. Any experienced computer user is aware of the problems and difficulties that can arise in using a computer. Thus, strong reliance was placed on quality voice interaction and the clear verbal description of what was going on when assistance was required. It took some time to illicit such interaction but such effort was justified in that the interactions became increasingly spontaneous and relaxed.

Of interest to the educational technologist was the use of the Apple Control Panel Device CloseView which enabled the magnification of the screen image for the viewer. Thus, pull-down menus could be greatly magnified for ease of visibility and dialogue boxes could be presented in a meaningful fashion. CloseView proved to be a very powerful tool and it is of interest that Apple describe it as an aid in increasing access.

So a course of word-processing was transmitted out to the above remote centres enabling access for many people who had had no previous experience in using computers. The last word-processing session focussed around the design of a letterhead using a logo developed with the ClarisWorks graphics module and saving the document as stationery , so that it could be used for all letters, etc.

The major difficulty in the delivery of the computing was the developing of sufficient local area network maintenance skills by the LNC co-ordinators. A poorly maintained host computer's hard disk makes access to necessary files, folders and applications software by the students very difficult. Also, the prime purpose of the computers at the LNCs is to enhance the use of the machines by the students. The writer at times wondered if the machines were being used at all, from one weekly lecture to another!

As a consequence, one of the major recommendations of the writer is that suitable software such as Timbuktu Remote or Apple's AppleShare Remote Access be purchased and installed at the LNCs and Perth, to enable the remote management and accessing of the host machines hard disks at the LNCs by personnel at Perth. Until sufficient skills are acquired by all LNC co-ordinators, such measures will be necessary. This leads to the question of the process of the training of the LNC co-ordinators. All training in the technology used has been done by the writer on an "as needed" basis, using the video conferencing system, as time and staff availability permitted. It is recommended that the issue of suitable training of future co-ordinators be considered a priority.

Despite the above, my full commendations are extended to all the co-ordinators for achieving as much as we did given the time and conditions under which we operated.

Telematics and Electronic Classroom

In the literature, telematics will refer to both terrestrial links of computers using the telephone network as well as motion video transmission using satellite transmission. A term used to describe just the sub-set of interactive computer -based dialogue, with screen sharing, and two-way voice interactivity is audiographics and that is the term this writer will use in reference to the trials in telematics using computers that have taken place.

The audiographics software used was the Australian-developed Electronic Classroom, which enables the interactive sharing of both text and graphics between remote Macintosh screens. a standard audio link using, say, Telecom's Conferlink or a conferencing bridge or the South Australian DUCT system, enables the interactive sharing of sound across the remote sites.

A Macintosh without additional serial cards installed can link up to at most two remote sites, via the modem and the printer ports. Any site can be the "teacher" or originator. Trials only have proceeded in the use of Electronic Classroom, with link -ups to all centres occurring and a multi-point link to Derby and Kununurra happening towards the end of semester. Multi-pointing required the purchase of an additional modem by the writer. These test links enabled the checking of the quality of the phone lines for the modem links as well as the appropriate baud rates. Connection at times appeared to be unpredictable although they were occurring with greater reliability towards the end of the six-month trial period.

The aim of the audiographics was to provide tutorial material in the above units of Mathematics and Statistics that supported the lectures given by satellite. This was done on several of the test occasions with the transmission of prepared "lessons" in mathematics going out to students at Derby. The system itself requires a little training in its use, in learning how to use the text and drawing tools with confidence. Thus, time was spent in this training of both the LNC co-ordinators and students.

The LNC co-ordinators are thus in a position to link-up amongst themselves using Electronic Classroom and learn its capabilities. The point being that each of the LNCs could itself become an originator of lessons, seminars or tutorials at all levels of education. The medium is a powerful one indeed, as well as being cost effective.

A bid for funding under the Apple University Consortium was placed in early May for funding for an additional serial card as well as modems to enable delivery to more than two remote sites. It is hoped to deliver tutorials to other centres such as Narrogin using the medium of audiographics. Also, the bid included the cost of a data-show for one site to enable the projection of the remote site's computer screen onto a larger screen so more students could conveniently watch and interact. The current version (Version 1.13) of Electronic Classroom is not compatible with an AppleTalk network, although the next version (version 2) in development will have the capability of being used by ten or so machines at each site or node of the network. At the moment, its use is restricted to just two machines per site, one the host computer such as the LC connected via modem to Perth, and the other machine a Classic connected directly to the remote host computer by the printer ports. Thus, even with the current software, it is possible to connect to two other sites remote from the originator (eg. the writer in Perth) and have two machines running at each site.

An exciting feature of the Electronic Classroom is its ability to support colour and some fun times have been had with students and LNC co-ordinators playing with the colour and graphics capability of the Electronic Classroom. The writer looks forward to using audiographics to a greater extent in the second semester of the Networks for Learning trial and, again, recommends strongly its consideration as a presentation medium for remote students at all levels of education. The ability to down-load prepared text, graphics and whole lessons make it a very versatile medium. In conjunction with aids such as a data show, Electronic Classroom and other similar telematics software offers an alternative to the very expensive video-conferencing technology. The potential for use across a wide variety of disciplines and areas is large indeed, with great possibilities in the area of teaching literacy. The combination of text, graphics, sound and colour is an unbeatable one.

Further, the writer has been exploring the use of Apple's QuickTime to compress the graphics and text files for faster file transfer. At 2400 baud, the transfer of prepared files on Electronic Classroom can be annoyingly slow. However, with suitable compression and perhaps the use of 9600 baud modems at all centres, the transfer rates will increase appreciably. It is an area of intense interest. Robert Crago, the Queensland developer of Electronic Classroom, has developed a QuickTime literate version that enables the down-loading of PICT files such as scanned images and video frame grabs. Experiments by the writer with the beta test version of this software are proving very encouraging and thus the potential scope for the use of Electronic Classroom has expanded further. The writer must express his appreciation of the support and assistance when asked of colleagues at the Western Australian Ministry of Education, Chas Bray, David Lockheed and Rob Black. The Ministry has pioneered the use of audiographics in this State and their advice and support is gratefully acknowledged.

Computer Conferencing

Experiments have taken place in the area of computer conferencing, which is different from audiographics in that the activity is purely text-based communication via the computer alone. Audio connection is, of course, available if one use the phone as well. Computer conferencing has been done in a simple point-to-point fashion only, using the communications module in ClarisWorks. Thus, it is being used in the "chat" mode within interaction between two sites only occurring. This has been stimulating for both parties . There is something about interacting in real-time via text on a screen that has its appeal. There is only the cost of the STD modem call and night off-peak rates might enable a student and a lecturer/ tutor to interact effectively, providing, of course, that both parties have access to modems. Perhaps further use of computer conferencing might encourage the effective night time use of the LNCs with tutor's in Perth. Investigation should proceed on the use of suitable gateways or pads that would enable the use of cheaper AUSPAC rates for connection. The medium has strong potential for developing literacy skills in a non-threatening fashion that is yet still personalised and human.

E-mail

As part of the Networks for Learning trial, Roger Atkinson from the External Studies Unit (ESU) at Murdoch University had seed-funding to implement an E-mail project using Telecom's KeyLink. Due to a variety of factors, this project did not get fully implemented until the final week of the semester. KeyLink accounts were not provided by Telecom until late May and Roger had implemented the necessary KeyLink hierarchy by the first week in June.

All the learning network centres are account holders, as well as Roger and members of the ESU at Murdoch, Dr. Wally Howse as Chair of the WALNC committee and Gay Short as Executive Officer of the WALNC project, as well as this writer. The writer, the LNC centres and Roger have KeyLink addresses; the rest hold AARNet addresses. Hence, part of Roger's problems as the KeyLink administrator was to work out addresses that would enable the exchange of e-mail from AARNet to KeyLink and vice versa.

The system is now operational and functional, although there are limitations. The writer has transferred binary files of prepared work to the LNCs to be down-loaded by students at the other end for use in the word-processing computer classes. Thus, formatted documents etc. can be transferred to the LNCs. Such documents, however, will not be transmitted across the AARNet gateway and can only be transmitted as unformatted text files. However, this is not significant as there is no real need to transfer such files across the AARNet gateway.

The writer is excited by the potential of the KeyLink connections with the LNCs and a question to consider is the cost effectiveness of using the e-mail process to down-load at the LNCs prepared lecture notes for classes in Mathematics, Statistics and Computing for the co-ordinators to then print out as a usual word processor document, photocopy and then distribute. The current procedure of faxing the prepared lecture material induces a loss of quality in the final distributed product at the remote sites.

At the very last satellite computer session for the semester, the writer had tremendous pleasure in working with students at Broome and Derby developing an automated log in process for the 2400 baud AUSPAC 01924 number and gaining access to KeyLink for the first time at these centres. This was done without the LNC co-ordinators being there! We went through the User name and password process and e-mail was received by the students. They then composed a letter off-line using the word processing module in ClarisWorks and mailed this to ALL CENTRES. Thus, all addresses on the WALNC KeyLink network received e-mail from the students at Broome and Derby. At the time of writing, it gave me great pleasure to be told that members of the KeyLink network are now replying to this mail.

The writer has developed elementary documentation for the logging on and composing mail process. The log-on process has been automated to an extent by the use of a stationery ClarisWorks comms document that dials AUSPAC upon opening. Also, the writer has developed short-cut key stroke macros that will enable the full automation of the log in process, although there is pleasure to be had in logging on and entering passwords and the like.

It is hoped that extensive use will be made of the e-mail facility in second semester to enable the transfer of files of work to and from students, to maintain contact with both the LNC co-ordinators and other members of the network.

Fax Modem

The last development that can be remarked upon is the potential for the use of fax modems for the down-loading directly from a computer of a word-processed or other documents, to be delivered as a facsimile at the remote receive site. At the time of writing, the author has just received a NetComm FaxModem 24 having placed an order for one nearly six months ago! Experiments on its use will take place shortly. However, the availability of e-mail via KeyLink might obviate the need of a fax/modem to a certain extent. The down side of down loading of prepared files at the remote site is that the co-ordinator or other must access KeyLink, down load the chosen binary file, open it with the appropriate application such as ClarisWorks, and then print it out on the printer. This would, however, produce a document with the same quality as the original, in comparison with a faxed copy either by conventional means or by a fax/modem.

Conclusion

Much developmental work in a variety of educational and information technologies has taken place in this trial period. There has been much to learn and master in order for the trial to proceed with some semblance of quality. The Department of Aboriginal Programmes within Edith Cowan University has transmitted satellite lectures in the areas of mathematics, statistics and computing, for six hours per week for the semester, that have been based on sound instructional design principles, as well as performing innovative work in the integration of the new technologies and media. Additional time has been spent in using the video conferencing facilities to train the co-ordinators in various necessary skills. Experiments and trials have taken place in the use of audiographics, computer conferencing and e-mail as means of delivery to the remote student.

Problems have been encountered in the use of interactive audio in satellite delivery and video conferencing. The writer recommends that further work on improving the audio links proceed with urgency. Consideration should be given to the Harvard Elite system. A means for incorporating the remote student's interactions such that they can be heard by students in Perth needs to be developed. A recent solution in the video conferencing situation has been the use of 008 dial-in numbers from the remote centres through to the conferencing studio or lecture theatre. This enables all on the network to hear in-coming calls clearly over the satellite broadcast and eliminates some of the feed-back problems present in the ConferLink system. However, such 008 dial-ins will not provide the necessary ready access to the lecturer that is required in intense interactive situations such as the computer classes. The mechanism of mobile microphones used in the lecture theatre in Perth for on-campus students is technically effective but not conducive to spontaneous interaction by local students. Thus, the remote students miss out on local interactions. A compromise between spontaneity and the general good will need to be made and adapted to.

The trial has, in a sense, been hijacked by the videoconferencing / telelecturing aspects. The concurrent State Information Technology's WestLink Project, with the ready availability of satellite receive dishes to the remote learning network centres and other sites , has meant that little time has been spent on exploring the other means of delivery such as audiographics. It is hoped that some resources will now be available to explore this medium more fully. Such development may well be essential as the WestLink trial comes to an end towards the end of this year and free use of satellite time will no longer be available. Increasing development of the ISDN network across the state will mean a growth in such modes of delivery as the PictureTel system which is cost effective but still beyond the means of the Learning Network Centres. Serious consideration needs to be given to exploring and developing alternative means of delivery other than concentrating on satellite telelectures. What will be the situation for the LNCs in 1993 and beyond if reliance is placed on this ageing and expensive technology, the cost of using which will presumably be born by the LNCs ? Recent developments in desk-top video conferencing, such as the Cameo system, may well provide many, if not all, of the features of satellite conferencing at a fraction of the cost. These developments are being followed with close interest by the writer.

The writer has found the last six months the most intellectually stimulating and creatively satisfying of his career. It has also been the most stressful. If development of new technologies is to continue, it is essential that staff involved in research and development be given release from some duties to achieve these ends. The developments undertaken by the writer during the Networks for Learning trial were in addition to his usual teaching responsibilities. However, as a result, the quality of teaching provided both internally and to the remote students has improved markedly. Internal on-campus students, despite the change in delivery style, have commented positively on the delivery of the lectures. Remote students now have access to education that was not previously available.

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Geoff Rehn is currently a lecturer within the Department of Aboriginal Programmes at Edith Cowan University. For the past two years, he has explored the use of the communications and information technologies in distance learning for the remote student. In particular, during 1992, he has been a prominent participant in two projects: the Western Australian Office of Higher Educations "Networks for Learning" trial and the State Information Technology's "WestLink Project". Geoff has delivered interactive lectures via satellite to centres across the State, as well as using audiographics in his teaching of mathematics, statistics and computing. In addition, he has facilitated statewide video conferences for Aboriginal agencies and communities. As well, he has a strong interest in interactive computer-assisted language learning and is exploring the use of video compression using Apple's QuickTime. Geoff is secretary of both the WA chapter and the National chapter of the Australian Society for Educational Technology, as well as being on the executive of the Perth based WA CBT Focus Group. He has particular interests in media integration and the refinement and adaptation of teaching skills to the new media. He can be contacted at: Department of Aboriginal Programmes, Edith Cowan University, 2 Bradford St, Mount Lawley WA 6050.

Introducing computer based education

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University of Queensland

Three varieties of computer based tutorial have been introduced and are described. The impact of one type was investigated. Studies took four forms:

1. Students answered questionnaires immediately after completing a lecture series, after parallel CBL tutorials, after a complementary laboratory session and after viewing a video.
2. Student use of CBL tutorials was automatically logged.
3. Comparison was made between the students results in multiple choice items common to 1990 (pre CBL) and 1991 (post CBL) examination papers to determine the impact of CBL on the respiratory course and competing courses.
4. Observations by the technical and academic staff were recorded.

There was a clear preference by the students for CBL over other forms of teaching material offered but it appeared that students' ratings of learning activities were based on different expectations. Analysis of examination results indicated a statistically significant improvement in performance after exposure to CBL. The paper discusses the implications of this and the role of CBL in the future.

Reflection on observation and research (Skinner, 1938, Hilgard and Bower, 1975), leads us to expect computer technology to provide an effective instrument for learning. The computer clearly has a capacity to capture attention with colourful graphics, animation and sound, it can provide opportunities to respond to questions and problems and it can deliver positive reinforcement for suitable behaviour and negative reinforcement and retraining for unsatisfactory behaviour.

Since 1984, our students have used computer simulations of animal physiology but it was only in 1991 that we first had the opportunity to develop our own computer based tutorials. Three variations of computer based tutorial have been introduced. One is essentially an illustrated electronic text, linked to a data acquisition program which students use during a laboratory procedure (Beswick, 1992 unpublished). The second variation is a set of interactive tests forming a companion to an instructional videotape (Oelrichs, 1992). The third variation combines testing and teaching by diverting students to an instructional tutorial when test items are answered incorrectly (Huxham, 1991).

This study was designed to determine if students found computer based learning effective and whether higher standards were achieved after its introduction. The study was also designed to identify and find solutions for any problems that may arise before the, presumed, more general implementation of computer based learning.

We chose to focus particularly on the computer based tutorials relating to pulmonary physiology because there was a commonality across learning activities in that one of the authors was entirely responsible for the development and delivery of the lectures and the computer based tutorials and jointly responsible for the video tape and laboratory classes.

Methods

Medical students assisting in this study were from the 1990 (pre CBL) and 1991 (post CBL) second year cohorts. During 1991 lectures were held at the normal times and after a brief scheduled training session students were able to access the computer based tutorials in their own time. The seven tutorials designed to parallel some of the lectures on pulmonary physiology were written for the Macintosh SE/30 computer using Authorware Professional version 1.6.1. The video tape used in this study was 'Pulmonary Mechanics in Health and Disease' (Huxham and Beswick 1990). Students had the choice of attending lectures, completing computer based tutorials or both. They were required to view the videotape in the audiovisual library and complete ten hours of laboratory work.

Studies took four forms:

1. Students answered questionnaires immediately after completing a lecture series, after parallel computer based tutorials, after a complementary laboratory session and after viewing a video.
2. Student use of CBL tutorials was automatically logged.
3. Comparison was made between the students' results in multiple choice items common to 1990 (pre CBL) and 1991 (post CBL) examination papers to determine the impact of computer based tutorials on the respiratory course and competing courses.
4. Observations by the technical and academic staff were recorded.

In the questionnaire we asked students to indicate on a scale of one to five: the overall effectiveness of the session, how well the objectives were defined, whether the objectives were achieved, if the level of detail was suitable, whether presentation was clear, if the content was relevant, whether the illustrations were helpful and how interesting they found the activity. Level of detail was rescaled so extremes 'superficial' and 'too detailed' both had a score of one and 'satisfactory' a score of five.

For each type of learning session the factor structure of responses to the questionnaire was determined using principle component analysis. Multiple regression techniques were used to show how individual items in the questionnaire jointly contributed to student perception of 'overall effectiveness' of the learning experience.

In the 1991 examinations, there were 85 multiple choice items which had been used in 1990. Of these, 15 related to respiration (supported by computer based instruction) and 24 related to other topics taught in the same semester. Forty-six items taught in a different semester were used for rescaling, by simple linear transformation, to allow for differences between student cohorts. Student's t-test was used for tests of significance between means.

Results

With a single exception there was a preference by students for computer based tutorials (p<0.01) (Figure 1). The exception was 'level of detail' where there was no significant difference in student ratings between the learning activities.

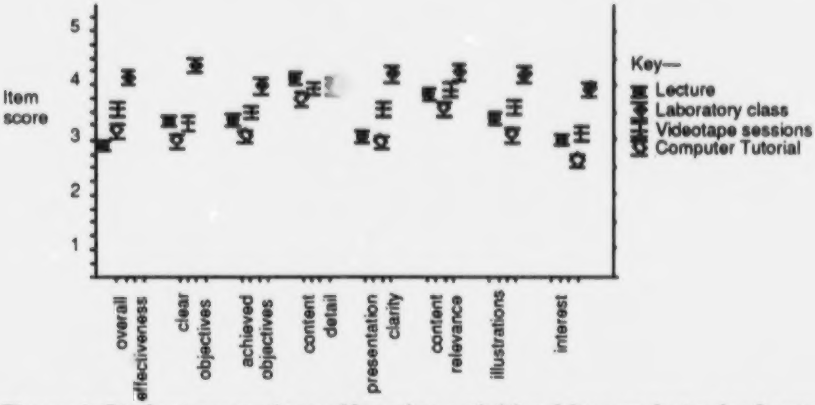

Figure 1. Student perceptions of learning activities. Mean and standard error of score allocated to each item on the questionnaire. Results are clustered by questionnaire item. The standard error was equal to or less than the standard error bars.

Factor analysis of the responses to questionnaire items is shown in Figure 2. In each analysis the eigenvalue of second and subsequent factors was less than unity, indicating there was only one underlying factor measured by the questionnaire for each learning activity. This interpretation is supported by the observation that the item 'overall effectiveness' had the highest eigenvector (correlation) for the first factor in lectures, laboratory classes and computer based tutorials, and was among the highest for the video tape.

	lecture	laboratory	video tape	CAL
eigenvalue	2.7	2.1	2.7	2.2

unrotated factor loadings:

	lecture	laboratory	video	CAL
overall	0.76	0.71	0.73	0.69
clear obj	0.67	0.55	0.76	0.55
obj achieved	0.73	0.58	0.75	0.57
presentation	0.71	0.60	0.72	0.68
relevance	0.51	0.48	0.58	0.64
illustrations	0.69	0.61	0.56	0.58
interest	0.73	0.63	0.60	0.64
detail	0.11	0.25	0.24	0.02

Fig 2. Factor analysis of responses to the questionnaires for each of the four learning activities. In every case the eigenvalue of second and subsequent factors was less than unity and so only one underlying factor was identified. Factor loadings represent the correlation of the variable with the extracted factor.

Figure 3 shows the contribution made to 'overall effectiveness' of each learning activity by the remaining quiz items. Unique contributions made by each item appear to vary considerably between activities. For lecture and computer based learning, several (interest, lucidity and objectives clear) made important independent contributions to overall effectiveness, while for laboratory classes and the video session, only one (objectives achieved) was independently important. Thus it appeared that students' ratings of learning activities were based on different expectations.

The mean score for 'respiratory' multiple choice items increases from 48.1±0.9, (n=210) in 1990 to 51.1±1.0, (n=228) in 1991 ($p<0.05$). Correcting for differences between groups suggested the true improvement may be slightly greater, to 52.4±1.0, ($p<0.01$). There was no decrease in achievement in competing companion topics.

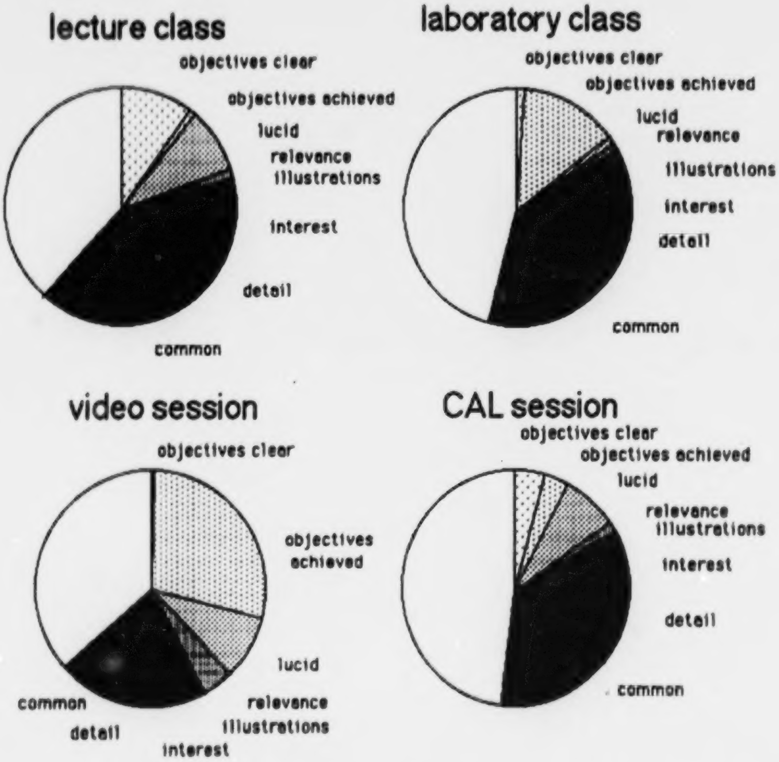

Figure 3. The contribution made to 'overall effectiveness' of each learning activity by the remaining questionnaire items. The area of the circles represents the total variance of 'overall effectiveness'. The shaded areas represent the proportion of variance uniquely predicted by the item. Common indicates variance predicted by two or more items.

The median time for the introductory tutorial was 9 minutes compared with a nominal time of 15 minutes. For the remaining tutorials which had a nominal completion time of 50 minutes, the median values of the actual times ranged from 33 to 65 minutes. Many students spent much longer than the expected 50 minutes, with some tutorials logging over 4 hours (Figure 4).

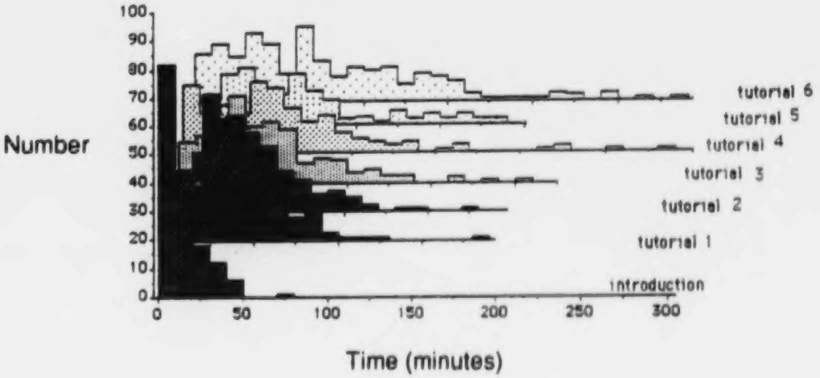

Figure 4. Time spent using the computer tutorials. 'Number' indicates the number of times the tutorial was used and could include up to four users, usually one or two.

Discussion

When courses are modified or new methods introduced there is an opportunity to assess the value of the change. Courses change continually. New pedagogical tools are offered to the teacher by sales representatives with the same enthusiasm, if not the same frequency or inducements, as new therapies are offered to physicians. Often it is a new book; sometimes it is a new device; a slide projector, movie projector, overhead projector. Often change is minor or subtle and evaluation is informal and based on the subjective judgement of the agent-for-change. At other times formal evaluation is omitted simply because staff are too involved in implementation to find time for evaluation.

In our study computer based learning tutorials were generally perceived by the students as better than lectures, laboratory classes or the video session in all categories except the level of detail.

Other attempts to determine users' perceptions of computer based learning have returned varying results. For example, Harbour (1988) used an inventory of twenty four learning activities and found that an 'audience of geologists and geophysicists' rated field trips and lectures much more highly than computer assisted instruction or videotapes. In contrast Orlansky and String (1981) reported students of the military forces indicated an overwhelming preference for computer aided instruction rather than for conventional instruction. It is likely that results of such investigations will depend very much on the quality of the learning sessions experienced by the group contributing to the study. If they had only experienced poor lectures and good computer based training the comparison would hardly be a fair one. In our study the group responding to the questionnaire was evaluating the quality of a very recent learning experience. All material for the learning experience was developed with a common author and related to a common topic. It remains likely that novelty was an element in the high rating given to overall effectiveness of computer based training.

When variation of responses was further analysed for patterns of consistencies and differences, only one underlying factor was identified. We assume this factor is overall effectiveness. However, multiple regression analysis suggested that items, perceived as contributing to overall effectiveness, were not given the same weight in the four learning activities. Interest, along with lucid presentation and clearly defined objectives, were given more prominence for lectures and computer based learning tutorials, while achieving objectives was treated as most important for laboratory classes and the video session.

Krein and Maholm (1990) compared the mean scores of two groups of students completing an auditor training program. Some students experienced conventional classroom training and others computer based training. The training modules for classroom and computer were both developed by the same team. The authors concluded that participants in the classroom did not measure up to those with computer based training.

Analysis of our examination results also indicated a statistically significant improvement in performance after exposure to computer based tutorials. It seems unlikely that the majority of students were spending a disproportionate time on the tutorials as examination performance in physiology topics competing for students attention did not deteriorate. Certainly some students were spending an unexpectedly long time working on the computer based tutorials, up to four hours on a single tutorial. This was possibly related to the tendency of students to take written notes at any opportunity. In 1993, formal notes given to students during lectures will be modified so that the parallel structure of the lectures and tutorials is more obvious.

The behaviour patterns of the students, as observed by staff, changed as their familiarity with the computer based learning programs increased, reflecting the self directed, self paced, interactive and therefore attention holding properties of the medium. We had hoped that students would enjoy working in small groups, interacting with each other as well as with the computer. This would have limited the demand for computers. However, many students who were happy to work in groups during the earlier tutorials preferred to work alone for later tutorials. The resulting increased demand for computers has been met by a booking system, by purchasing more computers and formal contact time.

Overall we regard the introduction of computer based learning as a success and intend to expand the facilities and broaden its application. As more computer work stations become available and the number of tutorials increases, we will have to answer the philosophical question of how much of our teaching time should be allocated to computer based learning. Clearly we have not yet reached the limit of the students' enthusiasm for this learning activity.

Acknowledgments

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Learning Needs in Industry: Meeting the Challenge

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Training Consultant

The article gives details of a strategy being put in place by the Queensland Electricity Commission to "change the face" of technical training within the Transmission Division. Assistance is given to subject experts to prepare learning "guides". Resources such as books, manuals, work instructions, diagrams, videos, site visits, subject experts etc. are selected as appropriate, and subject experts guide learners through the resources in as friendly and sympathetic style as possible. Each guide is short, with clear competency-based objectives and opportunities for self-testing. Study of the guide is followed by a computer-issued and marked test. The marking is characterised by significant feedback. Thus learners find out immediately how they are going and are given support. The unitisation of the material allows flexibility to meet individual needs. The computer is used to administer the whole process.

Background to the Challenge

Four to five years ago the Queensland Electricity Commission reduced its staff from over 5 000 to less than 3 000. The impact on those that remained was quite interesting to say the least. Firstly there was the loss of knowledge. Years of experience quite suddenly disappeared. Secondly those that remained could no longer rely on someone being available from the large pool of resources to help out when a problem arose. Everyone had to be able to do the job.

Suddenly, multi-skilling was not just something everyone talked about. Almost overnight, job sharing — the need to be able to carry out additional duties — became a necessity. Training was in demand. About that time, it was recognised that one of the best ways to rapidly and economically train small numbers in the details of a particular task was to use *self-paced learning* techniques. These are still based on identified competency standards coupled with an appropriate form of assessment, but the emphasis shifted from classroom instruction to providing an opportunity for learners to take some of the initiative.

QEC trialed the system in a recently introduced Trainee Paraprofessional Scheme. The trainees were given the opportunity to learn and be assessed for an identified task. The key to the exercise was the assessment. We didn't really mind how the knowledge was gained — we were mainly interested in the attained level of competency.

An interesting by-product occurred in that others who had been in the workforce for some time and who should have known how to do certain tasks better than they did, found a way of learning or re-learning without being embarrassed.

The Award Restructuring process has required a great deal of discipline in documenting workplace practices and needs. Work tasks need to be identified, skills and knowledge requirements documented and training developed to meet those "needs". Joint Working Parties, Joint Workplace Consultative Committees have had a role in this area, but for many industries the results have been disappointing. In particular, in-house, industry-specific training needs have not been clearly identified within any competency framework.

The Basic Challenges

Training needs can be placed into three overlapping areas:

- *broadband* —usually addressed by TAFE college, University Colleges, etc.
- *enterprise-specific* —addressed by a combination of learning providers and industry working together.
- location-specific — addressed by the particular industry usually by a combination of formal 'off-the-job' training and an allowance for 'on-the-job' training.

The challenges were seen as follows:

- The training needs of the workforce are diverse in subject matter, encompass all levels of complexity, and individuals (ranging in age from 16 to 60+) have individual skills gaps.
- Any training provided has to be **relevant** and **available on demand**. Most teaching institutions would have some difficulty with this, but in industry the link between pay and competency forces a demand from the employer for relevance and a demand from the employee for availability.
- Training material has of course to be competency-based with a special emphasis on the need for proper assessment.
- In industry the number of employees requiring training in any particular subject level often tends to be fairly low. You could have (say) three staff who need to be trained **now** in a particular aspect of the organisation's business.
- In some industries the employees tend to be geographically scattered. Travel and accommodation can become a significant percentage of the training budget.
- The employees have jobs, and the demands of the job can conflict with the opportunities for training.
- There is a lot of training material to be developed — too much for the few staff in Training Branch.

The Basic Strategies

The approach has been to self-pace the learning material, as much as possible, using recognised subject experts to write the content. Reference is made to relevant "in-house" knowledge and skills sources. These may be particular portions of an Australian Standard or manufacturer's operating manuals or maybe a particular person. Existing resources are always used where possible. Involvement of "in-house" subject experts, particularly "local experts", introduces local ownership to the material.

Thus, both in the preparation of the material and its "delivery", the approach represents a **decentralisation of training responsibility**.

Self-pacing of learning material and associate assessment leads into the development of question banks and automatically into "management of learning" processes. These processes are best handled by computers.

The basic strategies have been as follows:

- Identify areas of immediate concern. A full training needs analysis can be a lengthy and frustrating exercise. There's no compulsion to wait for results. If Department Heads enquire, they will find out where the most urgent training needs are and can make a start there.
- "Unitise" the material, where a *Learning Unit* would normally represent 1 to 3 hours of work. For industry-specific applications, many Units would include a theory and a practical component. Depending on the nature of this latter, a Unit could be much longer than 3 hours.

  The use of such Learning Units allows much more flexibility to provide **relevant** learning opportunities on an **individual** basis. On the preparation side, it distributes the work load.
- Keep instructor-led classes where appropriate, but move towards the development of **self-paced** (and unitised) material. This allows flexibility in giving the material a wider **availability.** Use short, expert-led tutorials after self-pacing so that learners get a chance to participate.
- Adopt the ***guides to resources*** approach and use a computer where appropriate to help with test issues, marking and general administration. A description of this process is as follows:

  Theory. For each Unit a Learning Guide is written, where each guide is designed to direct learners to resource material (manuals, regulations, drawings, videos, etc). Each guide includes "add-on" advice and expert knowledge as well as self-assessment questions with answers. On completion of a guide, the learner receives a printed computer-issued test. The answers may be manually marked (with marks entered to the computer) and the computer program will provide marking and feedback. In this way, the computer can be used to keep track of progress for each learner. A learner may need more than one attempt at a test.

  Practical. For the learner, directions concerning the practical component are included in the Learning Guide. Mostly they will require the learner to contact a nominated Instructor to be shown how to do something. When a learner is ready, another (practical) test can be issued by the computer. As well as giving instructions as to what to do, this test will normally include a "checklist" for the Instructor (or Supervisor) to mark. Again this practical "Pass" would be recorded in the computer.

  Courses and Topics. The use of Units allows a deal of flexibility in matching course material to individual learning needs. In practice, the Units are grouped logically into

- Topics and the some of the Topics forms the overall Course or Learning Program. However it is possible for a learner to choose individual Units to suit a particular need.

- The writing of a Learning Guide **must involve a subject expert**. If a Department Head identifies a training need, a subject expert must be made available to help course developers prepare the material. It cannot be on an "as available" basis. The current economic situation and its accompanying "slim-lining" means that spare time is a fast-disappearing luxury. The Department Head must sign on the line to provide subject advisers — who, when and for how long. **Anything less doesn't work.**

- The final strategy involves Quality Assurance. The guides and question banks are a **product**. Both the product and the process can be made subject to a Quality Assurance Scheme.

  The are many benefits to this, but the most important is that a well thought out Quality Assurance Scheme can allow for **maintenance** of the "product". Too often, after an enormous amount of effort has gone into preparing course material for some special set of lectures or seminar, six months later (and six years later) that same material is gathering dust on a shelf.

Making It Work

Within the QEC, these strategies are being implemented. Some of the immediate training needs have been identified, analysed and broken into Units. Subject experts have been identified and allocated time to produce the 'guide to resources' material and the associated question banks. Most of the required Quality Assurance procedures have been put in place including use of **external** instructional design checks. The subject expert must sign each page of the finished Guide for technical accuracy.

The use of the 'guide to resources' concept and computer-issued testing and administration needs some further comment from the point of view of its relationship with technology.

The Use of Guides

The guide gives directions and add-on value to resources. They are friendly and use 'throw-away' lines. They should give sensible, no-nonsense advice. They represent subject matter experts helping learners to learn. They should not be written as an extension of the teaching process. The form used is paper-based **for many reasons** including the opportunity for a quality presentation to adult learners. However, the use of a computer-based or computer-issued guide is not excluded from consideration.

A feature of the guides is the use of self-test questions (with answers in the back) and various activities. For example, before the direction to go and watch a video there could be: "Make sure as you watch the video you obtain the answers to the following questions:

Q1. How many ......?

Q2. Which of the following ......?

Q3. .... Yes or No?

These same questions will be asked when you receive your computer-issued test." This helps to keep the learners awake! There are many techniques and recommendations for writing "good" Learning Guides — most have come from experience.

The Use of Resources

The power of the 'guide to resources' approach is that for each Unit an independent decision can be made about the resource (or resources) to be used. For example, the development of a CAL package may be justifiable for parts of a number of Units, whereas it couldn't be justified for the whole program. Of course your first priority is to look for existing resources. All types of resources can be considered — manuals, old lecture notes, pamphlets, videos, audio tapes, CAL programs, site visits, subject experts, and so on.

While each learner receives an individual Learning Guide or set of Guides, a single set of resources can serve many learners. Another power of the 'guide to resources' approach is that the resources may be imperfect. The subject expert can 'talk' the learner through all sorts of possible difficulties, for example: "Skip Section 2.4 — its too hard to follow, and there's a much better explanation later in this Guide".

The Use of the Computer

As stated, the computer has two main uses — the issuing and marking of tests and (partly because it has done this) the ability to keep track of learners' progress. To a large extent courses can be tailored to meet individual needs by selecting Units and by the use of learner 'exemptions' at enrolment. There is a host of features relating to learning program and learner management and to the controls exercised over the issue of tests. This article now concentrates on the issuing and marking of questions.

Objective-type questions are those questions (true/false, multiple-choice, completion, numerical and all the variations of these) which are capable of being assessed by the computer for answer acceptability. The computer can issue **subjective-type** questions (essay-type questions, practical assignments, etc) but the answers must be assessed by an expert and the marks entered manually.

It requires a lot more work up front to set objective-type questions than it does to set an essay-type question. But the computer can do the marking and be used to give a lot of support feedback to the learner. This latter is important in an industry/commerce adult learner situation. There is no stigma associated with not reaching the given competency level on the first attempt. The learner follows the feedback advice and has a second attempt later. Failure is not an option.

There is a challenge in setting objective-type questions — it is an endangered skill. Within the Queensland Electricity Commission there has been a lot of development work in this area. Objective-type questions together with computer support are particularly appropriate in the "in-house", competency-based training area because:

- adult learners like the impartiality and anonymity provided by a computer marking system.
- the insistence on quality feedback forces a discipline on the subject experts. The testing is not threatening — it is meant to **support** the learner

- Competency-based training often requires high pass marks. A learner failing to reach the mark tries again later. The high pass marks virtually eliminate the traditional objection that students can pass by guessing the answers.
- The amount of marking work and the lack of uniformity associated with subjective assessments is eliminated.

Some Examples

For a typical Unit (theory plus practical) the normal process would be as follows:

- the learner follows the directions in the Learning Guide, i.e. assembles the resources and uses the add-on comments to work through the material. If the learner needs help he/she is encouraged to ask colleagues, supervisors or some nominated person in Training Branch.
- the learner receives a printed test and fills in the answers.
- these answers are entered to the computer (by the learner if he/she feels confident to do so — it's not very difficult — there are prompts from the screen)
- the computer issues the marking and feedback. The feedback should be fairly extensive and it would common for the length of this computer printout to exceed that of the original test.
- if the total marks are below a set level the learner takes another test attempt later. On passing the theory test the learner takes Test 2 for this Unit — the practical test. This is a description of all the things the learner has to do and would normally include a substantial checklist of what has to be achieved under what conditions.

  For this practical segment there should be an 'Instructor Guide' to show clearly what the instructor or supervisor role is, what has to be demonstrated, and so on.

  The Learning Guides have a set layout designed to be attractive to adult learners. A lot of thought was given to choice of font and use of different font sizes, white space, icons (not too many), and so on. In this we gratefully acknowledge help provided by the Instructional Design Unit, The University of Queensland.

Appendix A shows a typical page (page 7) from a fairly technical in-house Guide.

Appendix B shows three typical questions for TEST 1 as they would be issued by the computer. The full test included ten questions many of which were multi-part, and these are drawn at random from a bank of questions. Each learner receives a slightly different test and randomisation is possible **within** many questions.

- *Question 1* as shown is a multiple-choice question, but the choices are in random order.
- *Question 2* is a 'calculation' question where each number used has been chosen from a list of preferred values. (No two learners would get the same problem to calculate).
- *Question 3* is 'completion-type' for its first two parts, and 'true/false' type for the next three parts.

  The next page shows the marking and feedback for the above three questions. Note that for *Question 2* the feedback can show how the calculation was performed by the computer.

Appendix C shows two further questions to demonstrate some of the question possibilities.

- The first question is basically a completion-type, although there is some calculation involved. Note the tolerance possible on the learner answer when marking.
- The second question shows the numerical possibilities. The Diagram is simple enough to be drawn quickly using an extended character set. The values shown in the Diagram are "complex numbers" and chosen at random from a defined range. The learners could have been asked to express their answers in a complex number format.

  Note the "trick" in Part (a) of the question. The learner is given a clue as to where he/she ought to be, before proceeding further. The feedback can be as detailed as you like. Remember, no two learners get the same calculation.

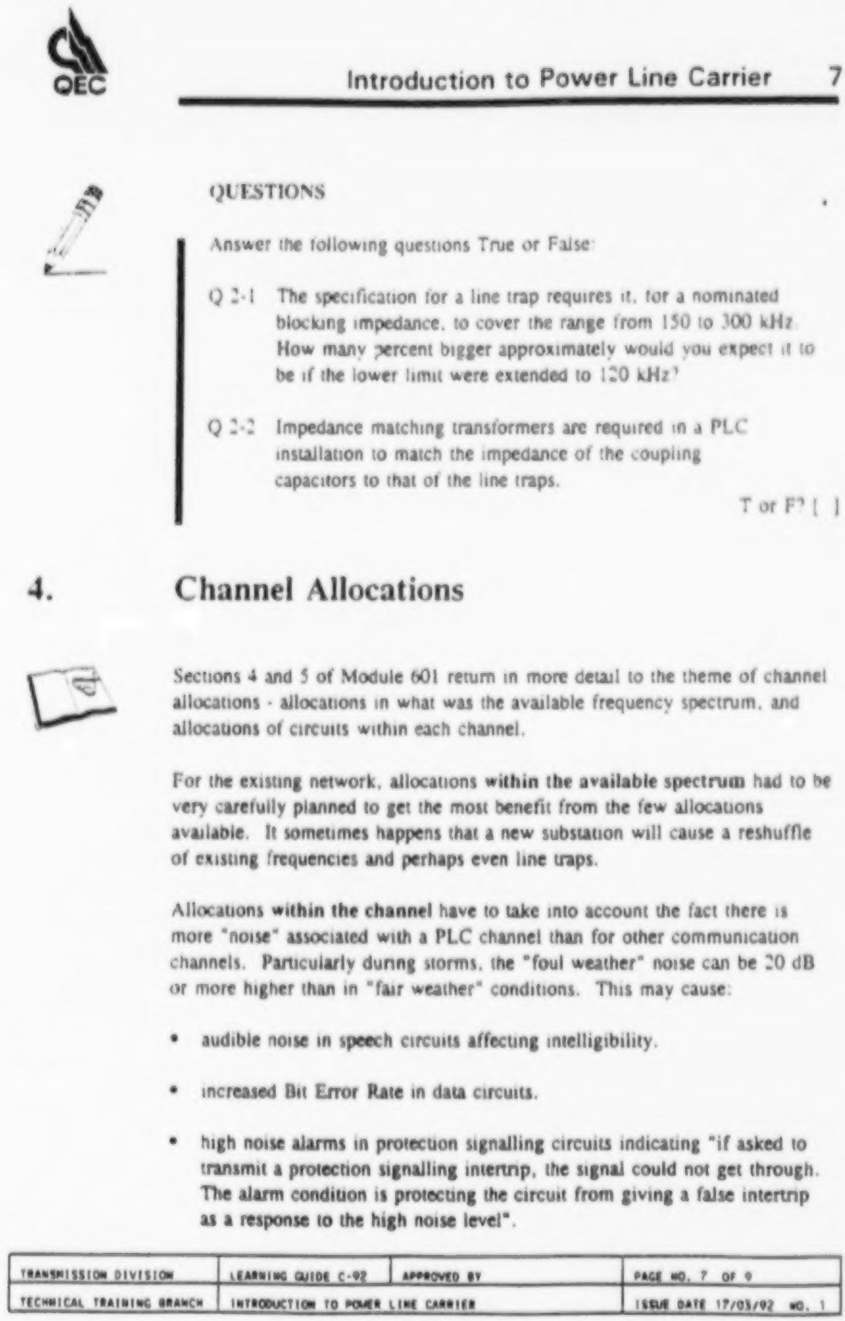
Conclusion

There is a commitment within the Commission to "change the face" of training away from centralised, instructor-led classes towards the use of self-paced, learner-centred Guides. While this will take time to put in place, it is believed that it represents the most effective strategy overall to cope with the expected increase in training requirements under Award Restructuring.

Rod Alford has been employed in the electricity industry for over 20 years, as an electrical engineer, initially in the areas of Construction, Operations and Maintenance and recently in training. The author is a member of the Queensland Electrical and Electronic Industry Training Council, Queensland Electricity Supply Industry Vocational Working Parties and Queensland Industry/TAFE-TEQ curriculum review committee. The author is currently involved in assisting in the introduction of a revised approach to training as part of the award restructuring process in the Queensland Electricity Supply Industry. He can be contacted at Queensland Electricity Commission, 72 Toombul Road, Northgate Queensland, 4013.

Nev Pryor's background includes four years as a lecturer at the (now) Queensland University of Technology as well as three years in the development of systems and methodology associated with Computer Manager Learning. The author's background also includes 25 years as an experienced engineer in the electricity industry as a sympathetic observer of the difficulties faced by adults with a desire and a need to learn, but with little opportunity, encouragement or assistance to do so.

APPENDIX A



QUESTIONS

Answer the following questions True or False:

Q 2-1 The specification for a line trap requires it, for a nominated blocking impedance, to cover the range from 150 to 300 kHz. How many percent bigger approximately would you expect it to be if the lower limit were extended to 120 kHz?

Q 2-2 Impedance matching transformers are required in a PLC installation to match the impedance of the coupling capacitors to that of the line traps.

T or F? [ ]

4. Channel Allocations

Sections 4 and 5 of Module 601 return in more detail to the theme of channel allocations - allocations in what was the available frequency spectrum, and allocations of circuits within each channel.

For the existing network, allocations **within the available spectrum** had to be very carefully planned to get the most benefit from the few allocations available. It sometimes happens that a new substation will cause a reshuffle of existing frequencies and perhaps even line traps.

Allocations **within the channel** have to take into account the fact there is more "noise" associated with a PLC channel than for other communication channels. Particularly during storms, the "foul weather" noise can be 20 dB or more higher than in "fair weather" conditions. This may cause:

- audible noise in speech circuits affecting intelligibility.
- increased Bit Error Rate in data circuits.
- high noise alarms in protection signalling circuits indicating "if asked to transmit a protection signalling intertrip, the signal could not get through. The alarm condition is protecting the circuit from giving a false intertrip as a response to the high noise level".

APPENDIX B

Test 1 - as issued

```
Date: 03 Aug 1992   GEC                                         CLMS (C) Page 1
Time: 09:17:05         Learning Unit 31 Test 1 Attempt 1        User: gu101

L.PRGM: PROT_1
Learning Unit INTRODUCTION TO POWER LINE CARRIER

Question 1. ( 4)  (92/01/007)
--------------------------------
In PLC channels it is common practice to reduce the usable upper range
from 3.4 kHz to 2.4 kHz.  This is done:

(1)  to achieve better speech quality
(2)  to reduce the overall noise in the channel
(3)  to allow data channels more chance of working when noise levels rise
(4)  to allow more signalling information down the channel

Enter your answer 1-4 [  ]
                  ========================================

Question 2. ( 10)  (92/01/008)
--------------------------------
Some power supply authorities purchase PLC line traps to cover the range
150 to 480 kHz with a minimum of 1000 ohms impedance.  Using the appropriate
formula, how much inductance would this line trap have RELATIVE to one of
similar construction, but with a frequency range of 120 to 300 kHz and a
minimum impedance over this range of 600 ohms.

Enter your answer to two decimal places [

                  ========================================

Question 3. ( 10)  (92/02/001)
--------------------------------
Consider the Figure in Appendix C of Module 601 which shows the frequency
response of a 'High Band' line trap.  The original specification required
1000 ohms blocking impedance from 300 to 480 kHz.  In fact, from the curve
supplied, this blocking impedance is achieved (enter your answer in kHz):

     from a low frequency of [     ]

     to a high frequency of  [     ]

This extension of the frequency range beyond that specified would allow
the end user:

     to install more PLC channels for speech circuits         Y or N? [ ]

     to install more PLC channels for data circuits           Y or N? [ ]

     to install more PLC channels for prot. sig. circuits     Y or N? [ ]

                  ========================================

***** End *****
```

Test 1 - as marked

```
L.PRGM: PROT_1
Learning Unit INTRODUCTION TO POWER LINE CARRIER

Question 1. ( 4)  (92/01/007)

     1                              Incorrect - Correct Answer is 4
Ans 1.  The restriction lowers speech quality in fact.
Ans 2.  The overall channel bandwidth has not been changed
        (300-3900 Hz, eg.).  Therefore noise into the overall
        channel is not affected.
Ans 3.  Any individual data channel ( eg. 480 Hz wide) will have its own
        filters which will restrict the noise.  This noise is then independent
        of PLC channel width.
Ans 4.  As simple as that.
                             Marks  0.0 out of  4.0

Question 2. ( 10)  (92/01/008)

     1.23                           Incorrect - Correct Answer is 1.53


                              K 1000 (480-150)
Inductance, 150 to 480 kHz  =  ---------------   =  4.5833 K
                                480 x 150

                              K 600 (300-120)
Inductance, 120 to 300 kHz  =  ---------------   =  3.0000 K
                                300 x 120

   RATIO  =  1.53
                             Marks  0.0 out of 10.0

Question 3. ( 10)  (92/02/001)

     250                              Correct
     550                            Incorrect - Correct Answer is 500
     y                              Incorrect - Correct Answer is N
     y                              Incorrect - Correct Answer is N
     y                                Correct
The program is set to accept 250 ± 10 and 500 ± 10 kHz for the low to high
frequency range.
The frequency extension above 480 kHz is not useful because allocations here
are not allowed.  Frequency extension below 300 kHz is still in the
"normally quiescent" zone, and can only be used for "normally quiescent"
protection signalling.  Since 300 - 380 kHz is already available for this,
the extension to 250 kHz would not represent much practical gain.

                             Marks  4.0 out of 10.0
```

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Question as Presented

```
..PRGM: PROT_.

Question 1. ( 2) (98/03/001)
------------------------------
A right-angled triangle has all 3 sides integers. If two of the sides
are of length 12 and 13, what integer represents the third side?

(a)   Enter your numerical answer

 (b)  When performing the calculation, whose theorem did you use?
      Enter your answer |
                  ========================================
```

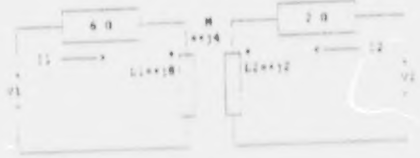
Question as Marked

```
Question 1. ( 2) (98/03/001)
                                       Incorrect - Correct Answer is 5
      7
If 12 and 13 were taken to be the sides, the hypotenuse would not be an
integer.  Therefore the hypotenuse is 13.  See Pythagoras' Theorem

      Pythagerus                        Correct
You have been marked as correct, but the correct spelling is Pythagoras
                                 Marks  1.0 out of  1.0
```

Question as Presented

```
Question 1. ( 7) (98/04/006)
------------------------------
In the circuit shown in the figure below, the two coils L1 and L2 are
mutually coupled with a coupling M = +j4 ohms and with polarity dots
shown at the top of each coil.
Find the voltage ratio V2/V1 which results in zero current I1.
Repeat for zero current I2.  (Note the current directions, and V2/V1)
```



```
     For zero current I1, ratio V2/V1 is:

      (a)  Enter your answer for magnitude to 3 dec pl.  |      |
           ( You should be within 10% of 0.66 )

      (b)  Enter your answer for angle to 1 dec pl       |      |

For zero current I2, ratio V2/V1 is:

      (c)  Enter your answer for magnitude to 3 dec pl   |      |

      (d)  Enter your answer for angle to 1 dec pl.      |      |
```

Question as Marked

```
Question 1. ( 7) (98/04/006)
                                 Incorrect - Correct Answer is 0.707
  (a) 0.111                      Incorrect - Correct Answer is -45.0
  (b) -22.2                      Incorrect - Correct Answer is 0.400
  (c) 0.333                      Incorrect - Correct Answer is 36.9
  (d) 44.4
The loop equations would be as follows:

      I1 (6 +j8)   +  I2 (+j4)    =  V1
      I1 (+j4)     +  I2 (2 +j2)  =  V2

It is only the numerator determinants that are of interest.
                                 Marks  0.0 out of  1.0
```

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The Use of Advanced Learning Technologies in Health Sciences Education

Allan Christie
University of South Australia

A review of computer based interactive instructional media that have been used in the School of Physiotherapy over the last five years. This includes the use of videodisc and videotape and studies of their educational effectiveness using the decision-oriented model of educational evaluation. Probable future developments based around digitisation of data in its various forms (video, still images, audio, text) and "in-house" CD-ROM mastering are outlined.

Advanced learning technologies hold great promise for student-paced and student-directed learning. In the health sciences area, "real-life" still images as well as video and auditory input are needed for the teaching of various techniques and assessment skills. Over the last three to five years the author has combined the interactive capability of the computer with videodisc and videotape in an effort to provide realistic learning situations for student. The results from studies undertaken on these methods of learning have been very encouraging with student attitudes being very positive towards these forms of learning and pre-test/post-test knowledge scores invariably showing a significant increase in understanding of the content after students have worked through the interactive lessons (Christie, 1988, 1992).

Videodisc

A videodisc on the topic of *Orthopaedics* was produced by the author in 1987 and software was written at the time using a DOS authoring language called PC-PILOT. A Videologic video overlay board and software was used to overlay the video image onto a computer screen thereby providing a single screen interactive videodisc workstation.

The decision-oriented model of educational evaluation was to used to provide a broad conceptualisation of the use of interactive videodisc in the undergraduate physiotherapy curriculum. The results of this evaluation can be found in the unpublished Master's thesis entitled *Interactive videodisc in physiotherapy education* (Christie, 1989).

This innovative educational approach has worked well with the City campus library of the University of South Australia now having six videodisc workstations with a number of different videodiscs which supplement, and in some cases, replace traditional teaching methods.

Videotape

The use of interactive videotape was also evaluated by the author in 1990-91 as it had the advantage of being easily edited and less costly than a videodisc. Although not having the random access capability of a videodisc a well planned instructional lesson can still provide student interactivity which is not compromised by slow response times resulting from the linear nature of the videotape system.

Students who used the interactive videotape lesson on *Movement Diagrams* had an overall positive response with the mean score of the attitudinal questionnaire being nearly three standard deviations above the mid-point of the scale. Not only was the use of the interactive videotape system a positive experience but it was also effective in terms of knowledge gained. There was an average increase in post-test scores of 15% when compared with the pre-test scores.

Factors which will affect wider adoption of this instructional medium include the complexity of linking analogue and digital systems (viz. videotape player and microcomputer). Indeed it proved to be more difficult than computer control of a videodisc player. As with the videodisc workstation the need for personal computers dedicated to this one function is a drawback and industrial quality videotape players capable of writing and reading time-code are very expensive.

Ongoing Development

A decision has been made not to develop further the use of interactive videotape because of the reasons give above, however, continued development of the interactive videodisc is presently been undertaken with a move from the present DOS-based courseware to Windows. This is being done for a number of reasons including the apparent widespread adoption of Windows on DOS machines and the ease of programming using "object oriented-like" software.

When reviewing the available application development tools for Windows there were a number of choices to make. Apart from programming languages for Windows 3.x such as Turbo Pascal for Windows and Visual Basic there were also Asymetrix ToolBook 1.5, Spinnaker Plus 2.5, IconAuthor 4.0, Guide 3.0, and Authorware Professional 1.0. Clearly academic productivity could be enhanced by these tools as quite complex graphics-based applications linking text, sound and video were able to be created much more easily than was previously possible using DOS-based authoring tools. In reviewing the above application software a decision was made to use Asymetrix ToolBook with the following considerations in mind:

1. The author's level of programming expertise.
2. What software development tools existed in the Windows environment which provided multimedia support?
3. Was there any one application development tool which seemed to have a critical mass of developers so that support and resources (routines, etc.) could be obtained if necessary?
4. How expensive were these tools — were there Academic editions?
5. Was I going to develop just for the Windows environment or perhaps multiple platforms (eg., Macintosh, OS/2, Unix)?
6. Was there potentially a commercial market for the courseware I was writing?
7. Could the courseware be easily modified to work with different types of video overlay boards?

As the author was already familiar with authoring languages, Turbo Pascal for Windows and Visual Basic were quickly excluded. This left five other development tools with Asymetrix ToolBook and Authorware Professional quickly emerging as front-runners because of the apparently large installed base and their support for multimedia. A detailed review of these application development tools is provided by Christie (1991) with an overview of ToolBook and Authorware Professional following:

Asymetrix ToolBook 1.5

A runtime license of version 1.0 of this software was packaged with Windows 3.0 for the first nine months and with the tremendous popularity of Windows there was, potentially, a large pool of users which had used, or was aware of, ToolBook. However, treacle ran faster than ToolBook 1.0 but its execution speed was improved greatly with version 1.5 and included support for 256 colours, larger scripts, improved Dynamic Data Exchange (DDE) support, enhanced printing capabilities and network awareness for file protection. OpenScript is the native scripting language of ToolBook and is functionally similar to HyperTalk for HyperCard (HC) so having some familiarity with HC meant little difficulty in using ToolBook. So similar are they that Heizer Software released a utility called ConvertIt! which converts HyperCard (HC) stacks to ToolBook books; something which is particularly useful when one considers the large number of public domain HC stacks available. Multimedia ToolBook 1.0 is also available which provides a set of extensions, through a DLL, to OpenScript, the native scripting language of ToolBook. Together with Microsoft's Multimedia Extensions for Windows and the Media Control Interface (MCI) of Windows 3.1 a powerful front-end for multimedia hardware can be developed.

Authorware Professional 1.0

This authoring language had its origins in PLATO which was principally a text-based authoring program on main-frame computers. It has developed through *Course of Action* to its current iteration called *Authorware Professional*. It has three main attributes;

- Object authoring — allows educational software to be developed quickly using a icon-based flow chart for the lesson design and authoring.
- Multimedia tools — sound, animation, video (built-in drivers for popular laserdisc players).
- Multi-platform architecture — files created on the Macintosh can be opened under Windows 3.0. XCMD's (external user routines written in C or Pascal) must be rewritten as DLL's to run under Windows. Files saved on the Macintosh using versions prior to 1.6 will not open under Windows.

With both packages having similar capabilities albeit using different approaches to development (ToolBook — "English-like" programming language; Authorware Professional — icon based, flow chart design), the final decision to use Asymetrix ToolBook came down to price and distribution policy. ToolBook (Academic Edition — AE) costs $325 with a 10-pack (AE) costing $2,395. A Multimedia ToolBook 10-pack costs $3,600. For both versions the runtime software can be distributed freely. With Authorware Professional the educational pricing is $1,985 for a single license with a 10-pack AE costing $12,500. A commercial license of Authorware Professional is $9,900 plus a royalty between 2 and 7% depending on volume of sales.

In addition to the updating of the Orthopaedic courseware to run under Windows 3.x using Asymetrix ToolBook 1.5 a new video overlay board called SuperVideoWindows from NewMediaGraphics is being trialed as it is a much cheaper option than the Videologic DVA-4000 board. More recent software for the SuperVideoWindows board uses MCI drivers, however, the author has yet to receive these so control of the videodisc player and configuration of the video overlay window relies on Dynamic Link Library (DLL) calls from within ToolBook. With ToolBook being an "object oriented-like" programming language it is envisaged that modification of the scripts to use the courseware with the Videologic DVA-4000 board should not be difficult.

Future

The analogue technology of the videotape and videodisc is inherently self-limiting in that each workstation requires a videotape or videodisc player and an add-on video overlay board to mix the video and computer signals. Future development plans in the next 12 to 18 months include digitising the video clips and still images that are on the videodisc and producing a CD-ROM using an in-house CD-ROM mastering device (eg., JVC RomMaker, Philip CDD 521 or similar device). This will allow delivery across networks and enable all student PC computer pools to be potential delivery sites of the courseware. Students will also be able to borrow the CD-ROM as they might a VHS videotape and play the CD at home on their own personal computer.

References

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Christie, A.D. (1989). Interactive videodisc in physiotherapy education: a study of the role of interactive videodisc in the teaching of orthopaedics in physiotherapy. Unpublished Masters thesis, University of South Australia, Adelaide.

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Allan Christie is presently employed as a senior lecturer in the School of Physiotherapy teaching in the areas of orthopaedics and sports physiotherapy in the undergraduate and postgraduate courses. He is the chair of the Advanced Learning Technologies Sub-Committee and a member of the Australia Health Informatics Association and the Australian Society for Computers in Learning in Tertiary Education. His current research interests include computer and optical technologies and their possible roles in both administration and education, user interface design issues in advanced learning technologies and evaluation models of educational innovations. His address is University of South Australia, GPO Box 2471, ADELAIDE SA 5001 or AARNet: Allan.Christie@UniSA.edu.au

The Parliament Stack

David Arnold
Parliamentary Education Office
and
James Steele
Interactive Multimedia Pty Ltd

The Parliamentary Education Office in Canberra is involved in the development of a number of innovative educational packages to support parliamentary and citizenship education across a broad range of curriculum areas covering the primary, secondary and tertiary education sectors. One package which has been developed over a period of more than two years is *The Parliament Stack,* a comprehensive computer-based collection of readily accessible information about Senators, Members of the House of Representatives and Members' electorates.

What is the Parliament Stack?

Challenging students to find out more about their political system and encouraging them to play an active role in it has long been a daunting prospect for teachers. Often the difficulty has been the lack of stimulating resources which might enthuse students and teachers alike to enquire into the political scene. *The Parliament Stack* is an attempt to bring together information about Senators and Members, their electorates, the latest federal election results, social-demographic information for each electorate from census data and much more. Students enjoy using computers to investigate and solve problems. *The Parliament Stack* taps into students' interest in computers and at the same time encourages them to examine interesting graphical and textual information about the political system.

The presentation-quality graphical material in *The Parliament Stack* is instantly available at the click of a button. Even teachers with little or no computer experience will enjoy the user friendliness of this program! These materials can be used by students and teachers in any number of ways, spending as little or as much time as is required to suit the classroom needs of a particular investigation. Senior secondary classes can be taken through more specific data allowing detailed comparisons between electorates based on a wide range of socio-economic indicators, or analysing the latest election results in comparison with other electorates around the state and throughout the country. On the other hand, *The Parliament Stack* can be used as a five minute stimulus only to introduce a particular political, social, demographic or geographical concept. The flexibility of the program is one of its greatest assets. The user can move through the program in almost any way. Unlike more traditional data bases the data does not hold the user captive!

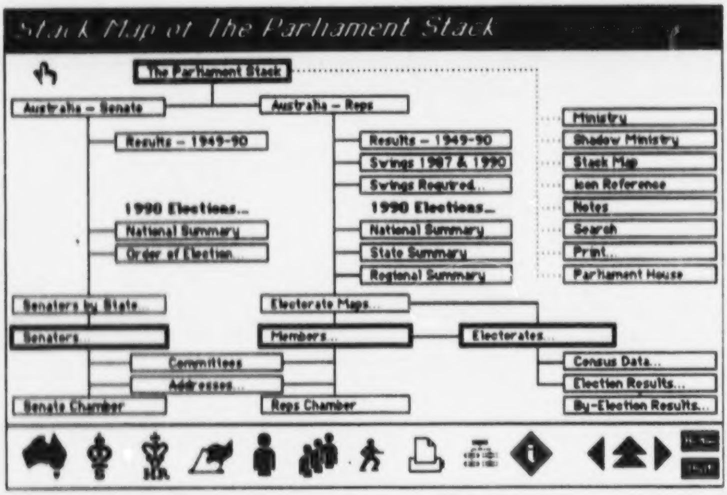

Stack Map of The Parliament Stack
The Parliament Stack
Australia – Senate
Australia – Reps
Results – 1949-90
1990 Elections...
National Summary
Order of Election...
Results – 1949-90
Swings 1987 & 1990
Swings Required...
1990 Elections...
National Summary
State Summary
Regional Summary
Ministry
Shadow Ministry
Stack Map
Icon Reference
Notes
Search
Print...
Parliament House
Senators by State...
Electorate Maps...
Senators...
Members...
Electorates...
Committees
Addresses...
Census Data...
Election Results...
By-Election Results...
Senate Chamber
Reps Chamber

Figure 1 — The Stack Map or map of *The Parliament Stack*. Each box is a button and will take you to the appropriate section of *The Parliament Stack*.

In politics where the only constant is change, the computer-based materials can be readily updated whenever circumstances change. The information in the *Stack* is as up-to-date as it can be, unlike printed materials where information can be up to three years old before a revised version is available (and even then it is usually out of date by the time it is circulated). With *The Parliament Stack* it is possible to make the changes as soon as any information is confirmed, such as after a Ministry reshuffle or an election.

Never before has such a range of information about Parliament been available in such a compact and easily accessible form, and interest in the product has come from a number of sources outside the classroom — journalists, lobbyists and Parliamentarians themselves are particularly keen to use the *Stack* in their work.

Using the materials is simplicity itself — using a mouse, and occasionally the keyboard, a user can access the information in a number of ways: graphically (by pointing and clicking at a particular point on a map) or textually (by searching for text typed in through the keyboard). Information in the *Stack* can also be accessed through the use of icons, small graphics representing particular functions or routines used to link the different sorts of data together simply but in meaningful ways. Additional information about a particular aspect is often available through pop-up menus, which are also occasionally used to provide different representations of data (transforming tables of figures into graphs, for example) where alternative methods of displaying data are appropriate for clarifying certain concepts with different audiences.

Using The Parliament Stack

A typical session using the *Stack* opens with a map of Australia showing the level of representation of either Members of the House of Representatives or Senators from each state or territory. Additional information relating to such things as previous election results (going back to 1949) and the state of the parties after the last two general elections is available through a pop-up menu. How much use is made of the additional information available through the pop-up menu (as is the case with all the pop-up menus used throughout the *Stack*) is up to the user — in other words the use of the *Stack* can be easily modified to suit the audience.

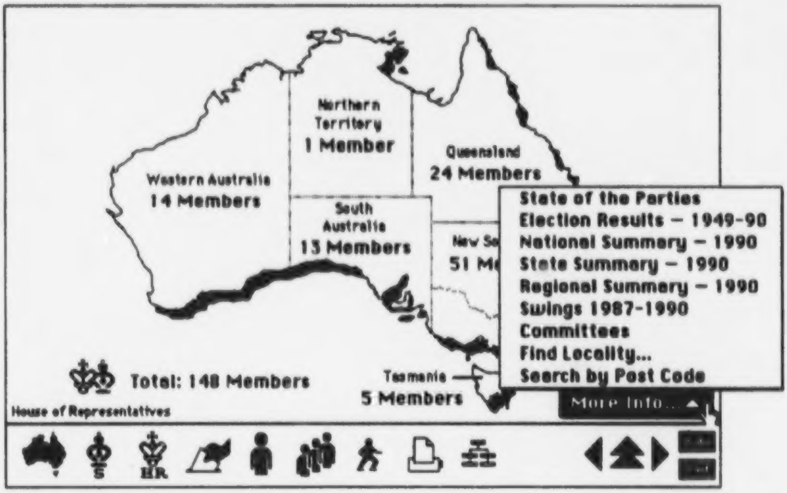
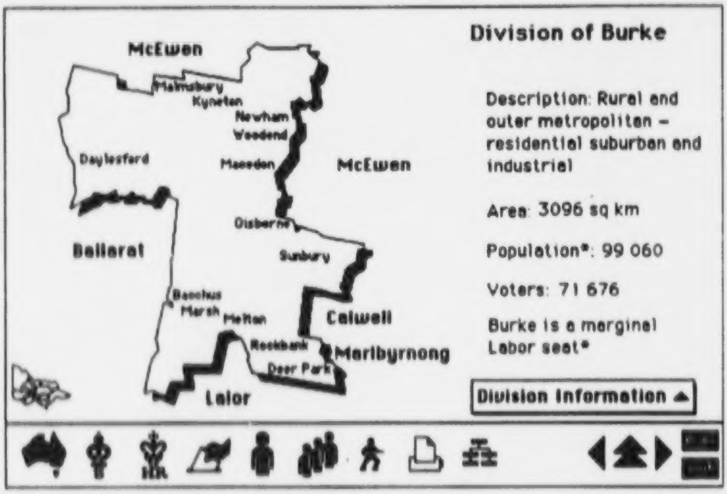

Northern Territory
1 Member
Queensland
24 Members
Western Australia
14 Members
South Australia
13 Members
New So
51 M
Total: 148 Members
House of Representatives
Tasmania
5 Members
State of the Parties
Election Results – 1949-90
National Summary – 1990
State Summary – 1990
Regional Summary – 1990
Swings 1987-1990
Committees
Find Locality...
Search by Post Code
More Info...
HR

Figure 2 — Map of Australia showing state and territory representation for the House of Representatives. The More Info… pop-up menu is showing

Often, students will be unable to name either their local Member or electorate. To find out the name of the local electorate, the user has three choices — using the map, searching by locality or suburb name or searching by postcode.

By clicking on the map, the user can "zoom" into larger scale maps of the particular area where they clicked. Using this technique, the user can go down from the map of Australia through a number of intermediate stages at a state or regional level to a scale where the audience can see individual metropolitan electorates clearly distinguished. At any of these levels, clicking on the names of individual electorates will take the user to detailed information about that particular electorate.

In addition to the basic information contained on the map, a pop-up menu leads the user to additional information (see Figure 4). For example, selecting the Election Results option leads to the presentation of information about the 1990 elections, 1987 elections and any by-elections held in the particular electoral division since 1987. Supplementary information about the swings required for a sitting Member to lose his or her seat is also available from the Election Results screen.


McEwen
Malmsbury
Kyneton
Newham
Woodend
Daylesford
Macedon
McEwen
Gisborne
Ballarat
Sunbury
Bacchus Marsh
Melton
Calwell
Rockbank
Maribyrnong
Deer Park
Lalor
Division Information ▲

Division of Burke

Description: Rural and outer metropolitan – residential suburban and industrial

Area: 3096 sq km

Population*: 99 060

Voters: 71 676

Burke is a marginal Labor seat*

Figure 3 — Typical Electorate Map. Statements relating to the marginality or otherwise of seats are judgements made statistically by the Australian Electoral Commission on the basis of the vote at the previous election.

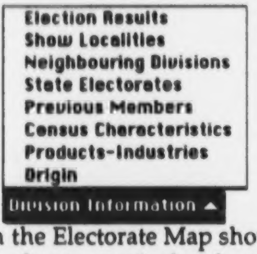
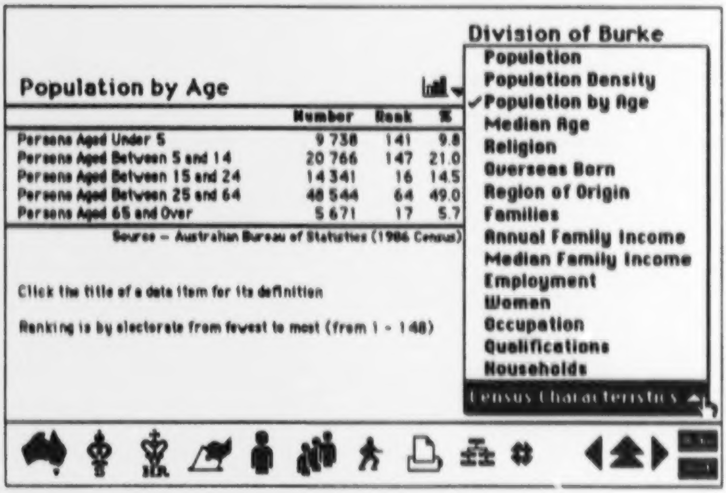

Election Results
Show Localities
Neighbouring Divisions
State Electorates
Previous Members
Census Characteristics
Products-Industries
Origin
Division Information ▲

Figure 4 — Pop-up menu from the Electorate Map showing the options available for finding out further information about a particular electorate.

One other option of particular note in this pop-up menu is the Census Characteristics option. Selecting this option takes the user to a screen where they can access census information relating to the electorate based on 51 different socio-economic indicators derived from data collected during the 1986 census (soon to be updated to 1991 census data) and mapped onto electoral boundaries by the Statistics group of the Parliamentary Library. The Parliamentary Education Office has taken this data further by graphing the indicators relative to all other electorates so that clear comparisons can be made between electorates (see Figures 5 and 6).


Division of Burke
Population
Population Density
✓Population by Age
Median Age
Religion
Overseas Born
Region of Origin
Families
Annual Family Income
Median Family Income
Employment
Women
Occupation
Qualifications
Households
Census Characteristics

Population by Age

	Number	Rank	%
Persons Aged Under 5	9 738	141	9.8
Persons Aged Between 5 and 14	20 766	147	21.0
Persons Aged Between 15 and 24	14 341	16	14.5
Persons Aged Between 25 and 64	48 544	64	49.0
Persons Aged 65 and Over	5 671	17	5.7

Source – Australian Bureau of Statistics (1986 Census)

Click the title of a data item for its definition

Ranking is by electorate from fewest to most (from 1 - 148)

Figure 5 — Census Characteristics available from *The Parliament Stack*

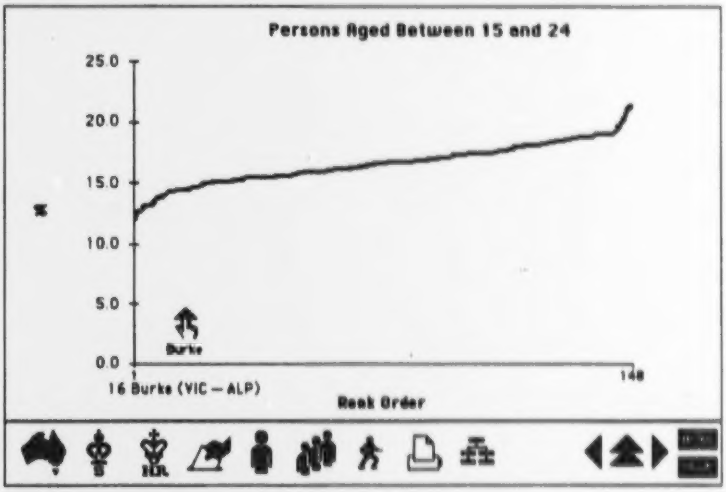
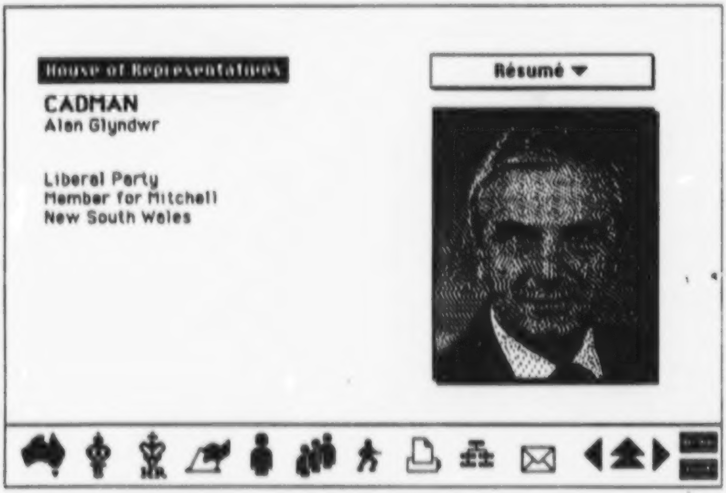


Figure 6 — One of the 51 graphs showing the rank order and level of census data for a particular electorate

Of perhaps greatest importance in the materials is the information about Senators and Members themselves. Each Senator or Member has a screen containing basic information about them — name, party affiliation, the electorate they represent (if a Member) and the state or territory they represent. There is also a photograph of the Member or Senator on the screen.

The Résumé contains further, more detailed information about a Senator's or Member's activities before and since entering Parliament. The pop-up menu contains the headings available where further information is available for the particular

Senator or Member concerned — a dimmed heading means that there is no further information under that heading (see Figure 8).

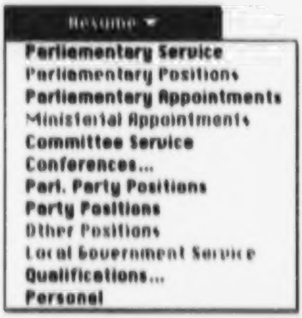


House of Representatives
Résumé ▾

CADMAN
Alan Glyndwr

Liberal Party
Member for Mitchell
New South Wales

Figure 7 — Card showing basic details about a Member of the House of Representatives.



Résumé ▾
Parliamentary Service
Parliamentary Positions
Parliamentary Appointments
Ministerial Appointments
Committee Service
Conferences...
Parl. Party Positions
Party Positions
Other Positions
Local Government Service
Qualifications...
Personal

Figure 8 — Pop-up Résumé menu from Members Card. Dimmed items indicate there is no information under that heading for this Member.

The Parliament Stack across the curriculum

Although *The Parliament Stack* contains information about Australia's political system, it was never intended that the *Stack* be used only in politics classes. Its statistics can be used in Mathematics classes; Geography teachers are particularly interested in the demographic details and the electorate profiles; Australian Studies teachers have found the products and industries information for each electorate and the census data particularly useful; Computer Studies teachers can explore the design and scripting elements of the *Stack* with their students. The *Stack* is also used in primary classrooms where students are asked to research various topics or prepare for an interview with their local Member or Senator.

Technical Information

The Parliament Stack is currently available on the Apple Macintosh or Windows 3.0 platforms. There is also a Macintosh CD-ROM version.

Availability of The Parliament Stack

The Parliamentary Education Office distributes *The Parliament Stack* to schools for $85 plus $5 postage. *The Parliament Stack* package contains a set of disks or a CD-ROM, a comprehensive user's guide and a teacher's guide. If you are interested in purchasing a copy of the *The Parliament Stack* please contact the Parliamentary Education Office and ask for as brochure.

Parliamentary Education Office
Parliament House
Canberra ACT 2600
Phone (06) 277 3058
FAX (06) 277 5775

Supporting the Multimedia Courseware Author: An introduction to the ACT-IT Project

Brian Inwood
City of London Polytechnic

Existing commercially available multimedia authoring tools provide a range of facilities that allows easy integration of the media elements, and some form of procedural control for media playback. Most authoring systems do not support the author in the courseware design cycle, which requires the author to have skills in the domain to be taught, a knowledge of the learners, a teaching strategy, a knowledge of interface design and aesthetic and creative abilities. The ACT-IT project is addressing these needs in various paper and computer-based solutions.

For the educationalist with limited resources the appeal of computer-based multimedia as a teaching tool is somewhat diminished when an attempt is made to construct a piece of effective multimedia courseware in a reasonable amount of time. Existing commercially available multimedia authoring tools attempt to shield the author from the technical complexity of media combination by providing a range of facilities that allows easy integration of the media elements, and some form of procedural control for media playback. The authoring facilities are presented as a set of available tools and little intended constraint of the use of those tools is placed on the author.

Preliminary work in the ACT-IT project has identified many other areas in which an author of multimedia courseware needs to be supported to aid in the production of that courseware. Just providing flexibility in media combination and procedural control does not help the author as the limits of their personal abilities in other areas of demand are reached. Authors also have real organisational and resource limitations to which authoring systems do not adapt.

The ACT-IT project is developing a system which will help authors of computer-based training courses to use multimedia technology to make learning easier. The emphasis is towards meeting the needs of learners who need extra help in learning IT skills. The ACT-IT system attempts to support the author in all aspects of courseware design and production, and to this end the ACT-IT system is a method which is realised in paper-based and computer-based support; that is, it is not just an authoring system as the ACT-IT author will be provided with a range of tools, guidelines, methods and other appropriate authoring solutions.

In developing the ACT-IT system the possible needs of an author were derived from first principles. It is from this work that the limitations of existing authoring systems have been recognised. This paper discusses some of the limitations of existing multimedia authoring systems in the context of producing effective courseware in a reasonable amount of time, and then describes how the ACT-IT project aims to overcome some of these limitations.

The working environment that has been specified for the ACT-IT project is 386 and 486 processor based desktop personal computers. The software aim of the project is to produce an authoring system for building courseware, with the emphasis on practical commercial results for any project outcomes. This paper works within that same perspective, and consequently limits its discussion of multimedia to that environment. Although the main emphasis of the ACT-IT project is towards learners who need extra help in learning IT skills, the discussion here does not preclude applicability to other situations.

Multimedia

The European Multimedia Centre (1991) describes multimedia as 'a convenient term to describe emerging and converging technologies'. This definition of multimedia has a technology-based perspective and correctly reflects the technology-driven nature of multimedia. Using this technology-based perspective the output media types usually associated with multimedia might be categorised as follows:

- text
- computer generated still graphics
- computer generated moving graphics (animation)
- real life still graphics (eg photograph)
- real life moving graphics (eg live video)
- sound.

This categorisation is arbitrary and has its basis in the way that the media are produced and manipulated using typical commercial multimedia hardware. In practice there is a spectrum of possibilities between the visual media elements, and there are associations between the elements, for instance sound is usually coupled with live video.

In the multimedia human-computer interaction the dialogue will be through a combination of both system output (the media types described above) and human input, and control of interaction. The control of interaction will involve all or some of:

- an interaction message
- an interaction object
- an input device.

To illustrate, the interaction message might be "press the button", the corresponding interaction object an on-screen button, and the input device a touchscreen. In a multimedia application the interaction message and interaction object can be made up of one of the output media types, and the input device is commonly one or a combination of:

- keyboard
- mouse
- touch-screen.

The popular view of multimedia goes further than meaning a natural extension to the usual text-based human-computer interface as just described — it also suggests user control, random access, repeatability, object orientated functionality, special delivery hardware and improved communication.

The improved communication of multimedia is the result of using more and richer media, and the result of special effects, combinations, and transitions of the different media. The special effects involve particular exploitation of multimedia. For instance a video sequence can be paused and an important area of the image highlighted. A video sequence can be co-ordinated with an animated graph to illustrate some dependent relationship. Perceptual illusions of some media are possible — 2D, 3D, 'trick figures', virtual reality, simulations of fabric or material type (eg text can be made out of chocolate); sound can appear to be in the distance, or close by. Transitions are possible between the interface types and include fade in and out, sunbursts, tricks (eg crumble, emerge from object), and magnify. One popular PC presentation package advertises as providing over 40 different transition types.

The Courseware Authoring Process

Multimedia applications can be constructed with a programming language (eg C++), although it is more likely that an authoring system will be used. An authoring system allows the easy and direct manipulation of media, usually with a visual interactive interface. Commercial authoring packages have various qualities and operating metaphors.

The PC authoring packages AuthorWare Professional from AuthorWare, Inc. and IconAuthor from AimTech Corporation use a flowcharting metaphor, where icons representing different procedural functions or screen snapshots can be selected and dragged onto the flowchart line, the resulting flowchart being the final multimedia construction. Functionality in both is powerful in the general sense, not catering for any particular application requirement.

Digithurst's *PictureBook* uses a book and page metaphor for media construction, where each page is essentially a screen snapshot. The pages are designed by the author to include objects, where the objects are either pieces of media or interaction objects with a particular given function. The functions provided allow for user control between pages in a final book. PictureBook provides a sophisticated search engine which allows a finished book to have hypertext qualities. Because of this facility books are especially suited to presentation applications.

Goal Systems's *Syllabus* is a multimedia authoring system aimed at the corporate market. Construction of multimedia is based around a list of tasks or objectives detailed in a text-based outliner. Actions at the base level of the outliner are associated with a set of one or more screen designs. Built into the multimedia constructions are user-monitoring facilities to help particularly in the building of courseware.

The hypermedia authoring package HiDES, developed at the University of Southampton, UK, is a dedicated system for collecting multimedia material into a set which can be linked together in a hypertext way. HiDES is particularly aimed at courseware building for the historian. Of special interest is its provision to a learner of a notebook where references to media (but not the actual content) can be recorded and saved for further use.

There are many other available authoring systems which work in similar ways, and provide various useful facilities. Presentation packages are also beginning to incorporate multimedia support, thus becoming possible alternatives to authoring systems.

The previous paragraphs describe the authoring functions in terms of what is provided by the authoring system. From the author's viewpoint, the authoring system is a tool in a cycle of development that iterates through phases of course design, course construction and course delivery to the learner. The phases are closely coupled in that course construction might aid the course design (eg a learner's notebook is provided by the authoring package as an option to the author, as in Hides), or perhaps the delivery module drives the course design (eg learner monitoring facilities are automatically provided in the delivery system for use by the author, as in Syllabus). The author is required to know what needs to be taught and how it will be taught. The author is required to design the course and the delivered system.

Some Benefits of Existing Multimedia Products

An examination of existing multimedia authoring systems, applications and courseware shows some common and useful elements, including the previously mentioned 'outliner', 'notebook', and the user-monitoring facilities.

Task-outlining is particularly important in the context of the ACT-IT project which is aiming to aid authors in the teaching of IT systems. Most IT systems are suitable for task decomposition (probably having been subject to a task analysis in systems analysis and interface design during initial product development) and so the provision of a facility to the author which allows a similar task analysis and a corresponding logical connection to parts of the produced courseware is going to be useful.

Note-taking is a well-documented technique available to a learner for more effective learning eg Bretzing *et al.*(1987), Suritsky and Hughes (1991), Peper and Meyer (1986), Nist and Simpson (1988). Among its other benefits, it promotes memorising and understanding of the material, allows for the permanent recording of a course for the learner's later use, and allows the learner to detail points that the course author could not have anticipated for a particular learner.

Successful existing courseware is characterised by having a good exploitation of multimedia capabilities, where success usually comes through good user-interface design. Typical of good user-interface design is the method of having fixed screen layouts used throughout an application. Areas are allocated for interaction controls, and a place for the media to convey the required message. In this way the user-interface design principles of consistency, orthogonality and 'look and feel' are addressed. Sometimes an application will use a technique from the set of common multimedia exploitation methods which are in common practice. These methods include 'talking heads' and maps. Both 'talking heads' and maps are supported in scientific literature as being useful for the purposes of teaching.

A 'talking head' can be and usually is a video clip of a human conveying the author's message. The 'talking head' enables the courseware author to speak to the learner in a very natural, flexible and human way, acting as the interface (from the learner's point of view) between the learner and the system/course, helping the learner to relate to the experience in a primarily 'human-human' way rather than 'human-machine' way. In a standard text on educational psychology, Glover and Bruning (1990) draw attention to the need to establish a good personal relationship between the teacher and the learner. They cite the earlier research of Rogers (1983) which suggests that effective teachers interact easily with learners and that learners tend to see them as 'warm' and 'authentic'. Glover and Bruning (1990) suggest that "Effective teachers are able to establish a rapport with their students from the beginning".

Maps are cues to the learner to enable them to track their position or status in a system. In the context of multimedia courseware a map has the purpose of providing the learner with an overview of the IT skill being learned and information about his or her current level of accomplishment with respect to it. The map can also be used as a navigation device, allowing the learner some choice about what to learn next. Maps basis in science and practice include the "knowledge of results" literature which demonstrates that learning (particularly perceptual and motor learning) can be enhanced by real-time feedback of performance details eg McCullagh & Little, (1990).

Limitations of Authoring Packages

Existing authoring packages primarily attempt to relieve the demands of technology in the construction of multimedia. Integration of multimedia hardware under operating system control (as in MicroSoft's Windows 3.1) is going some way to help in this direction, allowing any multimedia hardware to be used without unnecessary concern by an author of a particular authoring package. In the main an authoring package supports the assembly of multimedia, and will help in providing facilities for special effects, transitions, and combinations etc without any particular demands on the author. However, authoring packages provide little or no support in the areas of what might be technically possible (authoring systems provide a set of tools which the author is left to use to the best of their ability); and there is no concern for the actual production and manipulation of media content.

Software solutions to the production and manipulation of media content do exist, but require another level of ability. For instance the production of animations using Autodesk's Autodesk Animator Pro requires a good knowledge of animation principles and a high degree of skill to operate its sophisticated interface. A skilled operator can produce professional results, whereas a novice will struggle to produce something that would be acceptable in a serious piece of courseware. It may be that producing courseware will be a cooperative effort, where individual authors have different skills and levels of expertise — authoring packages do not explicitly support this cooperative work.

Authoring packages work from the basis of the author having all facilities when in reality an author will be constrained by the resources available, including:

- available hardware
- storage costs
- the type of delivery system.

Authoring systems could support the author in these areas by enabling the author to specify the delivery system for instance "I have a floppy disk, a PC with touchscreen, and I cannot use video". The authoring system then adjusts its operation to suit, perhaps disabling video support. The authoring system can then monitor the author as the resources are consumed and provide feedback like "you have used 60% of the floppy disk storage space".

The scope of the limitations described here work within the boundaries that authoring tools constrain themselves, that is they are to relieve the demands of technology. Little attention is paid to the demands on the author with respect to the courseware design cycle.

Demands on the Author

A multimedia authoring system that provides nothing other than a set of tools for media construction places many demands on the author working in the cycle of courseware development, including the requirement to have (amongst others)

- a detailed knowledge of the domain to be taught
- a knowledge of the group of learners and their needs
- a teaching strategy
- a knowledge of interface design
- a teaching style, and aesthetic and creative abilities.

These requirements are now considered using the following elements which have been identified as being present in pictorial messages (Barker and Manji, 1988). Although originally associated with single pictures, they apply equally well to the multimedia environment. The aspects describe the source of loads placed on the user (the courseware learner) of any message, which in turn the author must understand and consider in courseware design. Each one of the elements can be considered in the light of the loads on the author as previously described.

- message content
- context
- rules
- control functions
- aesthetic content
- other functions.

Message Content, Context and Rules

Delivered media has an actual deliberate message as determined by the author, it has embedded contextual rules that aid in understanding of that message, and most importantly in a multimedia environment there are contextual relationships with the environment, which in the multimedia application could be other media. Using the simplest of output media types that might be used in a multimedia environment (text) we can see the complications.

- Text can have meaning as written words.
- Text can have meaning as a pictorial construction of letters — in turn this picture could itself have meaning as a word, or meaning as a picture.
- Text can have nonsense meaning ie it becomes a pattern (although a pattern of characters could be incorrectly construed as having meaning).
- The text may be associated with other media, for instance it may a label for a photograph.

Similar levels of complication exist when using the other media types — computer generated still graphics, computer generated moving graphics (animation), real life still graphics (eg photograph), real life moving graphics (eg live video) and sound.

Control Functions

The author will need to consider the control mechanisms that will be provided to a learner, and who will have the control at any given time. Interaction requires consideration of the interaction message, the interaction object and the interaction device. The control can be over the individual media element, or the control of the complete system.

Aesthetic Content

Interface design is subject to a layer of consideration that has become known as the 'look and feel'. The types of things an author needs to consider in dealing with 'look and feel' encompass screen design, cultural differences including language and associated factors, the style of presentation be it formal, informal, brassy, etc, and environmental considerations, for instance a human in a dark room with audio speakers will have a different sensation to the human using the same system in a bright room and using headphones.

Other Functions

The primary purpose of a piece of courseware is to teach; for the author this means designing the mechanics of presentation of the constructed multimedia. The mechanics can range from whatever the author thinks best to using a formal recognised teaching strategy.

The ACT-IT Solution

As previously stated a multimedia authoring system that provides nothing other than support for media construction places many demands on the author of courseware, including the requirement to have (amongst others)

- a detailed knowledge of the domain to be taught
- a knowledge of the group of learners and their needs
- a teaching strategy
- a knowledge of interface design
- a teaching style, and aesthetic and creative abilities.

The ACT-IT system reduces the load on the author in these areas, by supporting the complete courseware design, production and delivery development cycle. The ACT-IT system also supports the author by adapting to the author's available resources, and by providing resource management aids. The support is provided through paper and computer-based guidelines, tools, methods and procedures. Each of the above areas of load have been identified as requiring specific support.

The ACT-IT project's remit is to work in the specific areas of teaching IT systems to learners who may need extra help in learning. To this end the ACT-IT system has knowledge about existing IT systems, and the problems that learners have. The author's knowledge about the domain to be taught and about the learner group is supported by this information in various ways. The knowledge is both static and dynamic, in that it is available as a reference for the author and in that it has a dynamic part to play in the design and construction of the courseware.

The ACT-IT project has a teaching strategy available for the author to use. Appropriate knowledge representations to support the chosen strategy are provided and these in turn help the author in structuring courses. The author may choose to vary the strategy in various ways.

The need to support the author in interface design, in style and in aesthetic and creative abilities is done in a variety of ways. One fundamental solution to this requirement in the ACT-IT system is to provide the author with templates. In its simplest sense a template is a fixed screen layout which an ACT-IT author can fill in with various media types. There is a set of templates available to the author of various configurations and purposes. The use of templates has various advantages, and addresses various problems of the courseware design cycle.

First, there are advantages to be gained in interface design. Evaluations can be done by the system designers on the supplied templates to ensure they conform to good user-interface practice, and a consistent 'look and feel' can be built in. The templates can be designed to exploit the benefits of using multimedia. Secondly, templates can be provided for specific purposes. These purposes could be for a particular teaching objective, or to cater for a particular learning ability or impairment. The templates can have functionality built in, including user control. Finally, the use of templates allows the author to concentrate on course building rather than screen and interface design.

Conclusion

The pressures to exploit computer-based solutions in teaching increase with the needs to educate more and a wider range of people, in a variety of subjects. These people may be students in traditional teaching institutions, or they may be the person on the street who is disadvantaged by not knowing how to use current information technology. Courseware designers and producers will use multimedia in pursuit of this wider education, but will require more and better tools to match. The ACT-IT project is one of many research activities that is pushing in this direction.

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Interactive Audio and CALL on the Macintosh

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In this paper, the author briefly outlines some of the work he has undertaken using the built-in sound features of the newer Macintoshes, in the development of genuine two-way interactive audio language teaching. In particular, he discusses the use of some of the advanced features of HyperCard 2, as well as his experiments in using Apple's new QuickTime in the digitisation of colour pictures, video and sound. The paper will be supported by demonstrations of current developments including digitised video on the Macintosh. the session should prove of interest to the specialist language teacher as well as those interested in multimedia applications in general.

This short paper outlines developments that have taken place in the use of interactive sound on the stand-alone Macintosh since earlier experimental work done by the author in September / October of 1991, the results of which are fully described in the most recent edition of the *Australian Journal for Educational Technology* (Rehn, 1992a).

In that article, I discuss the potential of the built-in sound features of the newer Macintoshes such as the LC, IIsi and the Classic II for the development of interactive computer-assisted language teaching, without the necessity for the addition of extra hardware or software. I describe my experiments with the AudioPalette in HyperCard 2, as well as the difficulties encountered in achieving genuine two-way interactive sound using AuthorWare Professional. I also indicated that language teachers should consider the possibilities of exploring the use of the sound features on the Macintosh, given the priority shown to the new technologies in the then recently released Australian Language and Literacy Policy (ALLP).

My own pre-cognition of future directions was not of any benefit to me as an application for funding under the Innovative Languages Other Than English in Schools (ILOTES) Program in May of this year was unsuccessful (Rehn, 1992 b). I'm sure many amongst you have had the bitter experience of having a seemingly worthwhile project denied funding. However, it was my first experience of having to come to grips with the apparent vagaries of funding bodies and I must admit the experience was a most disheartening one.

Those who have read my AJET article would be aware a prime development was a prototype Nyungar (or Noongar) language teaching module that was interactive, incorporated graphics, text and two-way sound. Nyungar is the threatened language of the south-west Aboriginal people of Western Australia. My ILLOTE proposal had the unqualified endorsement of the Nyungar Aboriginal Language and Culture Centre who have done productive work in preserving the language, in a traditional print- and audio-cassette based mode. They saw my work as providing a very powerful resource for the language teacher, as well as building upon the known effectiveness of computer-assisted learning for Aboriginal learners of all ages.

Thus, I thought I had everything going for me in the ILLOTE project proposal with its apparent emphasis on endangered indigenous languages and new technology. A denial of funding certainly dampened my enthusiasm for some time and, like many others, I queried the rationale of the decision-makers! However, I am pleased to report that Apple's new QuickTime with its capacity for compressed video, colour graphics and sound have recently rekindled my interest. This paper is then to be considered a report on a work in progress.

In hindsight, I realise that perhaps a project proposal that was centred around just a small language group could hardly qualify for a project of national significance. However, the proposal had broad significance not so much in its narrow language base but more in the application of the technology used. In addition, my proposal to develop a HyperCard-based "language shell" for the teacher to "customise" as needed was not sufficient to gain funding.

Expansion on early developments

The earlier work was based upon previous work done by the Nyungar Language and Culture Centre in which elementary graphics were drawn (in black) and the English and Nyungar text related to the graphic stimulus was provided. These graphic images were scanned in and provided the graphic stimulus on each card of a HyperCard stack. The user had a choice of English or Nyungar to be spoken and the stack had the ability to let the user mimic the played back sound of the expert speaker and compare their attempts with the expert speaker.

Since that early work, use has been made of HyperCard 2's ability to incorporate colour pictures onto each card, using the Picture XCMD provided in the Power Tools stack. The earlier black and white scanned graphics were coloured (in one colour only) in a paint package (UltraPaint) and incorporated into the stack using the above Picture command. This has increased the visual appeal of the earlier work but limited the application to colour machines, such as the LC and IIsi.

Developments using Apple's QuickTime

One of the most exciting developments in recent times has been the availability of Apple's new QuickTime compression utilities. The Picture Compressor utility enables the compression of large PICT files, such as those produced by a colour graphics package or scanned images at 256 or more colours, to manageable sizes so that such pictures can be speedily opened up and viewed on the screen. Early experiments using this compression technique have proved its potential. The intention will be to photograph situations, flora, fauna and the like to use as the graphic stimulus for the computer-based language teacher. This will be dependent on time or funding. However, prototype experiments indicate the methodology is sound.

More stimulating are the QuickTime MovieMaker and MoviePlayer utilities. These utilities enable the digitisation of video (and sound) and their compression to workable size. However, the question of what is workable is a mute one. As you will know, the digitisation of even a second or so of video at a low quality requires large storage space. The intention of the developmental work was to develop applications tat would be useable on a stand-alone Macintosh. Should such developments in video digitisation require larger mass-storage systems such as removable PL/I cartridges, this prime aim will be lost.

Current experiments by the writer in the use of QuickTime compression of video would indicate that it may still be possible to incorporate video in a floppy-disk based language teaching system which is module based. The intention is to visually record the expert Nyungar speaker on video, digitise the result and incorporate the additional option of the user being able to see the face of the speaker on screen, with a focus on the movements of the mouth. It may be necessary to record the voice of the speaker separately and digitise the sound as has been done in prior work, rather than use the sound tracks off the video tape. There are questions of sound quality that have yet to be investigated.

At the present moment, difficulties have been encountered in using the MovieMaker on the Macintosh Quadra which is the machine the author is using for developmental work. A NuVista+ card is installed and the writer is experimenting with a beta-test version of a QuickTime extension provided by Firmware to enable digitisation of video with the NuVista card. The MovieMaker has difficulty with recording sound as well as video, at the same time. Experiments using the MacRecorder as opposed to the in-built microphone of the Quadra would appear to be leading in a more fruitful direction. However, the writer needs to acquire the most recent MacRecorder driver (1.0.2) to pursue this work, as the original 1.0 is unsuitable for the Quadra. However, the MacRecorder with its separate line input will enable the sound from the video source to be digitised along with the video signal.

Provided with the QuickTime Developer's CD ROM are a series of HyperCard XCMDs that enable the very easy incorporation of video (and sound) movies into HyperCard stacks. Prototypes have been developed using these XCMDs that will be shown. The writer has yet to pursue the question of incorporating digitised video into AuthorWare Professional. However, he suspects that this task will not by any means be an easy one, given that the current release of AuthorWare does not support any HyperCard 2 XCMDs and that great difficulty was encountered in endeavouring to incorporate two-way sound into AuthorWare. However, the issue will be pursued in the future.

Conclusion

The author has developed a working prototype in two-way interactive sound for the Nyungar language of the Aboriginal people of the south-west of Western Australia. This was done in HyperCard 2.1 using the in-built sound features of the Macintosh and the AudioPalette XCMD provide with HyperCard. Initially, the graphics were simple black and white.

Use of the Picture XCMD provide in the Power Tools in HyperCard enabled the incorporation of colour graphics in a seamless fashion onto the earlier prototype. Such developments restrict the use of the developed package to colour machines. However, of the newer Macintoshes, only the Classic II is both black and white and able to support in-built sound (ignoring the portables). In addition, many institutions, including schools, are including such machines as the colour LC in their computing arsenal.

Current developments are in the use of Apple's new QuickTime compression utilities, firstly in the compression of static scanned-in colour images and secondly in the potential for the use of digitised video as a means of providing the early with additional input on the correct spoken word. The writer looks forward to presenting his investigations in the use of this new technology, it is an area of great interest and stimulus. Apparently, the Department of Education, Employment and Training (DEET) will be calling for a second round of project proposals soon, sometime in August. It is hoped that this time a proposal will be viewed with favour and that the writer will be able to report a successful bid to the conference.

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Developing Evaluation and Design Methodologies for Multimedia Based Learning

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Given the nature of a multimedia environment: that is, one that uses a combination of media such a hypertext, image, sound, animation and video; the emerging use of multimedia in education and training; an alternative evaluation and research methodology with a range of applicability is required to fully ascertain the instructional potential and effectiveness of the technologies. This paper reports on the development of an enhanced case study technique which uses case study methods combined with the use of video, computer log files and 'speak aloud' techniques to provide qualitative data. The benefits and developmental problems of the method will be discussed along with examples of studies attempted so far. Some recommendations for the ongoing development of this method will be reported.

With the emergence of multimedia in education and training applications, research into how the various multimedia configurations affect different types of learners as well as identifying important elements of instructional design is required. The method (Carlson 1991) should be able to be used with an entire instructional system in real-life educational settings and not necessarily limited to controlled laboratories investigating isolated parts of systems.

The literature identifies the need to research and evaluate the educational and training multimedia environment using new strategies and from perspective's that include the human computer interaction and learning theories (computer applications providing a unique method of observing the learners decision processes). Carlson (1991) recommends research into instructional design and matching of learning styles to programs whilst Park (1991) suggests learner control principles and strategies; selection of information -representation forms; use of hypermedia as a CBI Knowledge Base and development of an intelligent Hypermedia as suitable areas.

Reeves (1991) suggests that investigations of multimedia should include observational and regression methods and recommends these because of the exploratory nature of research that must be done. Observational studies are needed to identify the salient variables, whilst regression and computer modelling methods may be employed to explore relationships among specified variables.

Park (1991) also argues that behavioural psychological paradigms and procedures used in traditional audio visual research, where instruction by one medium is compared to another, are not appropriate for studying the instructional applications of modern interactive computer technology. Procedures and strategies for dynamically selecting information representation forms during the ongoing process of instruction should be researched.

Exploratory Sequential Data Analysis (ESDA) for Enhanced Casestudy Methodology

One method that provides identification of salient variables for analysis, is an enhanced case study method. The case study method is enhanced by video, log files[1] and interviews and provides a collection of sequential data from which analysis may be done. This paper explores this method of data collection and the types of variables that are being generated.

A pilot study involving the provision of distance education materials on a CD-ROM (McNamara/Webster 1991) used a case study approach to gain insight into learning processes in a hypermedia environment and to identify various types of data and observations that could be made from an observational approach to research in multimedia. From this, further refinements were made to the method which included incorporation of log files and camera 'views' that were most appropriate to record the interactions of the participants.

Romiszowski (1990) suggests the use of case study approaches for situations which require variety, complementation of traditional evaluative strategies, bridging theory and practice and development of evaluative skills. These categories provide an appropriate framework for research into multimedia.

Other researchers have also explored the use of case study with video. Cobb(1987) conducted analysis of video-taped interviews to test hypothesis in real educational settings. Krajcik (1988) used the recorded video output from a microcomputer and student's verbal commentary via a microphone input. This technique allowed student's comments about their observations, perceptions, predictions, explanations and decisions to be recorded simultaneously. Kidder and Judd (1986) suggest that interview techniques provide opportunities to correct misconceptions, misunderstandings and clarify or probe inadequate or vague responses. It can be suggested that the storage of these methods on video tape allows further analysis by collecting data including the subtle forms of expression, for example, gestures, expressions, hesitancies.

Method

The method used in this study comprises gaining data from videotaping the session, log file generation, time display and interview. Prior to the session participants were required to complete a biographical questionnaire and were given tasks to complete during the session.

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[1] A log file is a computer file that may contain some or all of the following information: time;screen identification;commands used

The participants were seated at a computer workstation comprising of computer, monitor, keyboard and mouse. The workstation has used both PC and Macintosh computers, the former being used in a pilot study, the Macintosh in more recent developments. This change in platform was dictated by practical circumstances of availability of suitable software and hardware whilst retaining important commonalities.

Cameras were positioned so that two of the three were not intrusive to the view of the participant with the third being located a distance away so as to be as unobtrusive as possible. The video equipment was placed on the workstation as a component of the research environment. The images were recorded simultaneously to a give views of the participant, keyboard and mouse, and screen. Superimposed on this image was a time display accurate to .01 of a second.

The cameras were positioned to capture the screen fully and avoid any obstruction by movement of the participant. To achieve this, two cameras were dedicated to the screen and participant. The third camera was mounted overhead to provide a clear view of keyboard and mouse. The resultant image was recorded simultaneously giving the three views. The limitation of using a camera to capture screens of the test instrument was as a consequence of using available technologies. It is acknowledged that more sophisticated technologies are available to take the monitor output direct to a video tape source.

Throughout the recorded session participants were asked to 'think aloud' to assist in the clarification of their responses and provide insight into their thinking processes.

A log file was incorporated to time stamp the actions selected by the participant. The log file recorded the time of action, screen identification and command selected. A further file was recorded which displayed the history of the participant giving title of screen and duration since last visited. This was used to supplement information or clarify the screen identification from the recorded image.

On completion of the session the participants are interviewed. These questions sought responses to the program by the participant, identified difficulties and where possible, clarify responses observed during the session. These responses were taken in note form although future developments will include the use of audio taping the interview. Further interviews may be required following detailed analysis of the data.

The data gathered by the log file can be used in generating graphs or tables to display the comparison between the variables of screen identification, time, frequency of use of screens or commands and in identifying hesitations and common pathways. The data was displayed as a text file under a word processing/spreadsheet package and provided easy manipulation of the data.

The test instruments varied from an Electrochemistry program (Pilot study) to a hypertext style of program on the Macintosh which incorporated navigational mapping strategies. This change of test instrument was dictated by practicalities of available technology and compatible software whilst retaining important commonalities. The Electrochemistry program is part of a first year Applied Science degree and included hypertext, images, animation and a graphical user interface with an icon bar offering twelve functions. The Hypertext program was produced using

HyperCard and utilised mapping strategies for navigation through the information. Both programs are available on CD-ROM.

Participants were set tasks for each of the studies. Initially, the task was for students to familiarise themselves with the material and prepare for a formal assessment of the material contained within the Electrochemistry program.

For the report, the task comprised five questions, two of which were open-ended and required subjective responses. The other three questions were objective in style and required finding specific information. The three objective questions were given to provide participants with tasks that allowed development of the navigational strategies required by the program and to build confidence.

Discussion

The studies indicate that this methodology provides a method of going beyond the learning interface to reveal the cognitive processes that are being used. It is important to identify some issues that are raised as a consequence of this approach.

Pre session training may be required prior to involvement by participants in hardware to be used, types of software and think aloud procedures. The type of hardware and its demands on participants needs to be identified and suitable training provided so that routine operational functions do not intrude into the sessions. This may address aspects of mouse manipulation, keyboard entry of information and adjustment of screen intensity, angle and introductory setup of materials. The use of think a-loud procedures is useful, but effective use demands that voice levels are adequate and thoughts are expressed as clearly as possible and not muffled or slurred. Some of this may be overcome with a personal microphone located on the participant. Krajcik (1988) comments that when students did not verbalise their thoughts and observations, the investigator would provide prompts with comments such as "please share your thoughts with us" or "please say what you are doing". As much as possible, the investigator allows participants to work through the programs without interference but encouraging them to think aloud. This area requires skilful intervention by the investigator and judgement so that there is not an overindulgence in interruptions.

Preparing the participant and providing background information and insight into investigation aims may influence results. If participants in the study know what outcomes are anticipated, there may be impact on the outcome or results obtained. This raises the question of the risk of taking the results out of context and applying them to aspects of multimedia training and learning inappropriately. This will be more accurately assessed as patterns and trends become identified over a number of cases studies.

Conversely, there is a research responsibility to identify organisational preliminaries, to place the sessions in context and gather important biographical data along with the opportunity for participants to become familiar with the type of environment in which they are working. This would include the opportunity to raise questions and discuss aspects of the session that they felt required clarification. This pre-session time was ideal for encouraging the tone of interaction between the researcher and participant and establishing a personalised environment in which the participant was relaxed and could more accurately reflect the type of workstation environment that they would encounter in actual use of a multimedia type program

The personalised environment was enhanced further by the presence of only the participant and investigator during the sessions. The participants appeared relaxed in the environment and not perturbed by the extra amount of recording equipment which surrounded them. All participants involved themselves quickly in the program with only a little prompting required by the investigator for explanation or reinforcing thinking aloud procedures. In future sessions this will be monitored more carefully as it provides insight to the cognitive processes that are being observed and explain hesitancies and decision making processes.

There are some encouraging observations and trends are emerging at the early stages of trailing this method. These include factors relating to technology(Table 1), learning (Table 2) and contextual related issues(Table 3).

1.	Ability to utilise program features
2.	Influence of prior computer experience
3.	Computer style interface preferences
4.	Use of the mouse in a tracking role
5.	Reference to help systems

Table 1. Technology Factors

1.	Confidence
2.	Hesitancy
3.	Confusion
4.	Satisfaction
5.	Efficient and inefficient learning
6.	Periods of inactivity
7.	Periods of high learning activity
8.	Periods of loss of interest
9.	Time to reach significant points of knowledge
10.	Desire to know limits of system
11.	Exploration vs direct pathways
12.	Linear vs browsing
13.	Eliminations
14.	Synthesis of information
15.	Confirmation of existing knowledge
16.	Strategies
17.	Interest and motivation levels

Table 2. Learning Factors

These listings and categories are preliminary indicators and may be modified as further analysis is performed. Although video analysis can be extremely time consuming and difficult, the use of log files and dialogues provide 'signposts' to segments of the session that are of interest to the researcher. If, for example, the log file indicates a lengthy time on any one screen that segment can be viewed on tape and analysis made of the cognitive processes or other factors that occurred. The sources of data are seen as providing a number of perspectives from which the researcher can draw on to assist analysis of specific areas of interest.

1.	Structure of menus
2.	Participant's understandings of instructional statements
3.	Return to known position/screens
4.	Most common pathways
5.	Tools and features used/unused
6.	Attitudes to design

Table 3. Contextual factors

Conclusion

Whether this method does adequately tap into learning styles and cognitive processes will become more clear with further case studies. However, where human interaction with a computer is concerned, this method does provide a realistic environments in which to undertake further research in areas discussed in this paper. If multimedia is to be a worthwhile educational technology it must be meeting the needs of a variety of learning styles in a highly personalised human-computer environment.

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The Core Safety Training Project: A networked, multimedia, competency based training program

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Since June 1990, Woodside Offshore Petroleum Limited and the University of Southern Queensland have been involved in the design and development of courseware to meet the needs of the Core safety Training Project. The program was initiated by the Woodside training department in answer to a number of issues affecting the efficient and effective safety training of Woodside Production Division employees working in the Pilbara region of Western Australia at the Onshore Gas Plant, Heliport, the Supply Base, Town Office and on the North West Shelf offshore drilling and production facilities. The nature of the Woodside operation and the fact that employees were located at a variety of worksites led the company to consider self-paced multimedia learning and the development of training programs containing consistently accurate and up to date information over time. The training program had to cater for differing abilities and enable individuals to take training courses at any time during the year. Traditional training techniques did not fit the bill as they did not provide the flexibility desired.

Twenty one of the fifty courses targeted for development have been finished and implementation of the completed courses has commenced. With 40% of the courseware developed, it is planned to complete the design and development of the remaining programs by the end of this year. This paper summarises the scope of the Core Safety Training project, its components, the establishment and operation of the consultancy, courseware design and development and the process of course implementation.

The development of self-paced multimedia training programs promises to provide a flexible, effective and efficient method of training Woodside production division employees. The benefits include both quality training and cost effectiveness that makes the self-paced approach to training attractive to industry. The University is using Authorware Professional software for the development of computer based training and assessment packages. The print based material is desktop published using PageMaker software and at the print ready stage it is electronically mailed to Perth for printing. Communication between the University and Woodside is via a Quick Mail computer link.

The self–paced, multimedia courses enable trainees to work at their own pace at any one of ten learning centres established specifically for the program. Learning is presented through a combination of print, video and computer managed learning and computer based training. The training programs are designed in such a way that the trainees become aware of how the material can be learnt. In addition it enables the trainee to acquire the skills for learning how to learn, opening the way for lifelong learning skills and motivation beyond what is currently being learned.

The Scope of the Core safety Training Project

The Core Safety Project was conceived to meet company needs to provide occupational safety, health and welfare training courses for Woodside employees, contractors and visitors working on the North West Shelf and Pilbara region production and logistics facilities. The program is relevant to over 700 employees, and will include visitors, contractors, and Head Office personnel.

The project was initiated to answer a number of issues affecting the efficient and effective safety training of Woodside Production Division employees and to satisfy the demand for Woodside to discharge its responsibility to provide quality safety training to all employees.

Most industries recognise the need for safety training to be responsive to business and individual needs, to carry consistently accurate information over time, within an 'auditable' training program. The problem facing Woodside was how to deliver quality training efficiently to new employees, who may join in small numbers, and have specific needs depending on their job at Woodside and the particular area in which they work. There were similar problems with internal transfers of employees between jobs and work areas where safety requirements differed. If Woodside was to discharge its responsibility for the provision of high quality safety training to all employees, in a timely and effective manner, 'traditional, face–to–face' classroom techniques appeared to be too cumbersome and inefficient to remain a realistic training option. To teach one topic required as many as three subject matter 'experts' to be drawn together to make classroom presentations to one or two new employees, and where different experts were used, consistency of information and checking of learning varied depending on the approach of particular presenters. In order to solve these problems it was decided to adopt a multimedia , independent learning style of safety training presentation which included classroom training where necessary as part of mixed mode presentation.

Working Relationship

Rather than installing the entire courseware production infrastructure at Karratha, it was decided to obtain external support for design, writing, and computer based training (CBT) development. Institutional and private providers of these services were interviewed across five states, resulting in a contract being awarded to the University of Southern Queensland on the basis of competitive tender across a range of strict criteria. This phase was established by July, 1990.

The Woodside Offshore Petroleum and University of Southern Queensland consultancy was developed over a period of time and reflects the need for constant consultation in the development of both course material and a harmonious working relationship. During the development of the consultancy process difficulties were encountered with the development of course matrices and some aspects of content where policy decisions had to be made. A very flexible approach was needed to overcome the problems in the early stage of the project and through a process of constant review the current consultancy, design and development model was established (Appendix B).

The consultancy is, as the name implies, a process of consultation in which both parties work closely together in an effort to produce the best end result. The process consultation model developed for this project involves the client owning the problem and the consultant providing the specialist advice, help and skills necessary.

The Woodside project coordinator and instructional design consultant work together over periods of two weeks to develop performance and enabling objectives, content and learning strategies which form the course matrix or blue print. Once the matrix has been approved, the cost estimates for the development and production of the courseware are determined and sent to Woodside for service orders to be raised.

Components of the Core Safety Training project

Hazards Analysis

To begin development of the Core Safety Training project, an analysis of Job and Area safety hazards was performed, with an emphasis on the importance of the hazard communication to new employees, contractors, or visitors. Large representative groups of Production Division staff contributed to this analysis phase. Related hazards were grouped into 'families', and these families of hazards formed the basis of the project courses (around 50), and subsequent curriculum development. The detailed curriculum content was derived using small teams of line staff with experience of particular hazard recognition and neutralisation. Employee involvement has been an on–going feature of Core Project development and implementation in order to ensure credibility and line 'ownership'.

Program Specifications

Tasks included in the establishment of the program included:

- hazard analysis and curriculum design
- target group reading age analysis
- project coordination — line staff communication
- contract establishment and quality control methods
- establishment of the three–tier model and delivery strategy
- module packaging and ergonomic considerations
- establishment of a video production and desktop publishing facility at Woodside Karratha
- data management and network operations
- hardware/software specification and selection
- specification of a Student Management System (SMS)
- establishment of learning centres
- piloting
- arranging implementation across all main sites.

Course Design and Development

The initial design process occurs at the Woodside training centre at Karratha in Western Australia. with the project coordinator, instructional design consultant and content specialists who determine the learning objectives for each course targeted for development.

Each training course is designed to incorporate a multimedia mode of delivery involving print, video and computer based training. The courses are designed to involve the trainee as much as possible through interaction with the different media.

The design process has been divided into three distinct stages.

> Design Phase 1: Involves the determination of learning and enabling objectives.
>
> Design Phase 2: In consultation with the content specialist the detailed content is decided upon.
>
> Design phase 3: The instructional design consultant develops the teaching strategies and assessment.

The three design phases are combined to produce a course matrix which, once approved by Woodside, acts as the blueprint for all design and development work thereafter. Notes about references and resources required by the design team are recorded on this document. (Appendix A)

Once the three design phases have been completed cost estimates are produced and sent to Woodside for approval. The development of courses does not proceed until approval has been received from Woodside. An example of the courseware development process is shown in Appendix B.

As soon as approval to proceed with courseware development has been received by the University project manager, a GANTT chart is produced to identify the production schedule, the personnel, resources and time needed to develop each program.

The preparation of all components of the training course are carried out at the Distance Education Centre at the University of Southern Queensland in Toowoomba. The technical writer produces all written material for the study guides, CBT programs and all assessment items. When rough drafts have been completed the design team at the University comprising a graphic artist, computer programmer and desktop publisher meet and produce the material to the clients' specification as agreed in the matrix.

Course Piloting

Two separate pilot programs were undertaken:

Systems Piloting. This process, involving Karratha based target group personnel, was used to verify the user friendliness of the media packages and navigation within courses.

Clinical Piloting. This process involved Perth based non-target group personnel. It's purpose, on a course by course basis, was to determine the teaching effectiveness of each course.

Course Components

Print—each trainee is presented with a course manual containing printed information and instruction. The study guide is designed to direct the trainee to each component of the training program and the different presentation media used.

Video—the video scripts are prepared by the University and actual filming and editing carried out on site at Woodside.

Computer-Based Training—interactive formative and summative assessment is presented through a variety of questioning and presentation techniques using Authorware professional.

Student Management System

The student management system used to monitor the progress and performance of all trainees and, linked to the computer based training provides a quick and accurate assessment profile for the student and management.

Profiling—All employees are profiled for selected courses (up to 30), according to their job/location. Profiles are managed by the Student Management System(SMS), where employee groups, profiles, and targeted courses are created. Profile updates due to job/location changes are automated via links to the Personnel database.

Enrolling—Once an employee is profiled for a course, that information appears to the employee in the SMS under " Refresher Courses". An employee can then electronically enrol in the course, and see the results in the SMS under "Enrolled Courses"

Courses—Courses use Multimedia, which may contain: text (Study Guides), video, CBT, Interactive Video Instruction (IVI), practical field activities, or classroom sessions. The study guide is the navigational medium for courses. The list of courses is shown in Appendix C.

Training History—Employees can see past course activity in the SMS under "History". Employee history is recorded on the Training REGISTRAR database.

Commencing Training—To commence training, an employee undertakes the following process:

1 Completes a Study Schedule with their Supervisor to determine priorities and completion schedules for profiled courses. This schedule then becomes a one-to-one contract between an employee and their immediate Supervisor.

2 Requests initial training packages (Study Guides) from the Training Centre, usually 2 or 3 of their profiled courses.

3 At times convenient to the employee and Supervisor, commences training at a Learning Centre.

4 Employees will typically complete the "First Course", before undertaking other courses. This course explains the Study Guides, and introduces the employee to the SMS, CBT courseware, and CML assessment.

5 To access the SMS , Employees enter their PN and password. The first time they enter the SMS, they are given a guided tour via a CBT program.

6 Employees then have the opportunity to complete CBT lessons, Self Assessment questions for course modules, or challenge the final CML assessment of a course.

Implementation

Implementation of the project was overseen by a Core Review Committee (CRC), comprising Superintendent level personnel representing different Departments. The process involves the following phases:

Phase 1 Selected courses undertaken by Staff level personnel.

Phase 2 Selected courses undertaken by award personnel.

Phase 3 Full course profiles available to all employees.

Management Guidelines—Due to the cultural change in allocation of training time this type of training imparts on an organisation, Supervisory personnel at all levels required guidelines for the management of study time. This was issued via the CRC prior to award personnel beginning training.

OHSE Representation—Before phase 2 began, Occupational Health Safety and Environmental representatives were inducted into the program. This familiarity by safety representatives allowed a smoother transition to award personnel.

James Burgess, Distance Education Consultant, University of Southern Queensland, PO Box Darling Heights, Toowoomba, Queensland 4350. He is an instructional designer at the University of Southern Queensland Distance Education centre. Enrolled in the Master of Education program specialising in Distance Education. At present working as the operational project manager, instructional designer and technical writer for the Woodside Core Safety Training Project. Previous experience as an instructional designer for the Queensland Open Learning Project Tourism and Hotel Management in 1990. Prior to joining the Distance Education Centre experience involved commissioned service in the British Army as a training officer, art teaching, instructional design and duties as an education officer for the Queensland Department of Education. Business experience includes the development and operation of a teaching aid business involving the design, development, production and marketing of material used in early childhood development for the Queensland Government and private education providers in Australia.

Greg Colgrave, Project Coordinator, Woodside Offshore Petroleum Limited (Training Centre) P.O. Box 517, Karratha W.A.6714. He is the Training Project Coordinator for Woodside Offshore Petroleum, having completed Trade, engineering and Educational qualifications. Currently full time employed on the Core Safety Training Project, previously employed as Instrument/Electrical training officer for Woodside. Prior to joining Woodside, gained Education/Industry liason experience as Coordinator Instrument/Electrical studies at College level, involved in the development of a skills extension program. Distance and remote education experience was gained in establishing post Trade courses throughout the Pilbara region of WA. Previous experiences include, industrial maintenance, UWA environmental research, and business proprietor.

Appendix A (i)

No. SAFE 000287

COURSE MATRIX

COURSE TITLE

FLANGES GASKETS AND BOLTING TECHNIQUES

General Aim:

This course aims to inform employees on the correct selection and replacement techniques for flanges, gaskets and bolts for piping systems

Target Audience:

All maintenance personnel (mechanical tradesperson:) who are required to work on the Plant

MODULE 1 : 6

PERFORMANCE OBJECTIVES	ENABLING OBJECTIVES
1 Be able to correctly select a gasket, bolt, blind flange or spade for a given task. (G B BF & S)	1.0 List the types of pipe and flange gaskets used on the Plant 1.1 State the method of identifying appropriate gaskets, bolts, blind flanges and spades (G, B, BF & S) 1.2 Be able to use identifying methods to select appropriate gaskets, bolts, blind flanges and spades for a given task 1.3 List the methods of obtaining gaskets blind flanges and spades (G, B, BF & S) 1.4 Obtain selected gaskets, bolts, blind flanges and spades
2 Demonstrate pre flanging job preparations	2.0 Be able to identify the appropriate permit for a job 2.1 Be able to prove that appropriate isolations have been carried out 2.2 Be able to test an atmosphere vent for a clear opening where applicable 2.3 List the techniques to be employed in minimising the amount of time that process pipework is opened
3 Demonstrate safe flange spreading techniques	3.1 Identify how to safely commence unbolting a flange 3.2 Identify the action on discovering excess pressure
4 Demonstrate safe gasket replacement techniques	4.0 Describe pre-removal preparations 4.1 Identify the correct gasket removal technique 4.2 Identify the correct flange cleaning technique. (The correct protective equipment must be used. This process is done by hand) 4.3 Identify the correct used gasket disposal procedure

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DATE 26/02/92

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MODULE 1 - 6

PERFORMANCE OBJECTIVES	ENABLING OBJECTIVES
	4.4 Identify the location of the Asbestos disposal bin
	4.5 Identify how to safely install a new gasket
5 Be able to correctly remake a flange connection	5.1 Identify the pre bolting preparations
	5.2 Identify the pre tensioning techniques
	5.3 Identify correct tensioning techniques
6 Demonstrate correct selection, installation and replacement techniques for instrument fittings	6.1 Identify appropriate replacement fittings
	6.2 Follow manufacturer's fitting instructions

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DATE 26/02/92

Print Material

COURSE TITLE Flanges Gaskets and Bolting Techniques

MODULE 1 - 6

CONTENT	GRAPHICS AND REFERENCE
1.0 SWAF - Spiral wound asbestos filled CAF - Compressed asbestos fibre Ring type - Solid metal ring, shaped	
1.1 Use (a) Piping and Instrument Drawings (P & ID) and (b) Piping Specifications	1.1 (a) P&ID - in MES office (Maintenance Engineering Supervisor) (b) Piping Specifications Document No A11505X001 - in MES office
1.2 For SWAF & CAF - from the P&ID • look up line number and size • refer to piping specifications • choose the appropriate F, B, BF & S	1.2 • P&ID • Piping Specifications
For Ring type - from the P&ID • look up line number and size • refer to piping specifications • choose the appropriate gasket • locate the source of information for ring type gaskets (ref AQUA TERRA)	• AQUA TERRA manual Cat 92 Section on MOORSIDE metal ring gaskets Page A143-A144 - in MES office
1.3 Can be (a) Ordered for them by supervisor (b) Selected from the free bin (c) Identified and ordered via the IBM selection	
1.4 Complete enabling objectives 1.1 to 1.3	
2.0 From the PSS - anytime	
2.1 • look for tags (Danger) on valves • ensure valves are closed • check that tags on valves relate to permits they have • look for tags on associated electrical equipment • check electrical equipment has been actually isolated (e.g. withdrawn from cubicle)	2.1 • Picture of tags on valves • Picture of tags on electrical equipment

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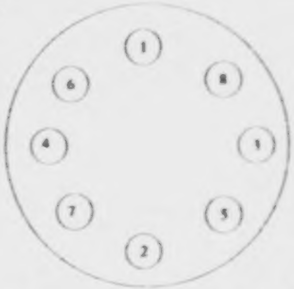
CONTENT	GRAPHICS AND REFERENCE
2.2 • All tools and equipment to be on the job prior to beginning work. • All access materials (e.g. scaffolding and rigging) is available, in place, and suitable for the job. • If process pipework is to be opened for extended periods (greater than 24 hours) the opening should be blinded off.	
3.1 Start unbolting with the volt furthest away from you. Reason - Any potential interal pressure is directed away from you.	
3.2 Retighten bolts and report to Supervisor.	
4.0 Lay down plastic sheet.	
4.1 Remove the old gasket to place in an Asbestos disposal bag.	
4.2 A gasket (or parts of one) may be stuck to a flange. Methods of safe removal are: • use of a scraper • a hand held wire brush - wet down with water first • emery cloth - wet down with water first No power tools to be used (electrical or pneumatic) for cleaning. Particles may become airborne. Check the cleaned surface for imperfections.	
4.3 Immediately place old gasket material into a gasket disposal bag. Available from Warehouse/Store.	4.3 Video of Asbestos Disposal Bag ☐
4.4 Currently outside Module 2.	4.4 Video of Asbestos Disposal Bin ☐
4.5 Leave gasket in packaging until ready to use.	
5.1 All bolts are cleaned and lubricated if required.	
5.2 Tighten the flange but do not tension it. Measure the flange gap for square seating during tightening.	

CONTENT	GRAPHICS AND REFERENCE
5.3 Use standard torque sequence techniques to required settings. e.g. 	5.3 Details on torque settings used - from Paul Smith ☐
6.1 The Plant mainly uses Gyrolock fittings. Swagelock are being phased out. The fittings are not interchangeable.	6.1 Video of Swagelock & Gyrolock tube fittings. Sufficient detail to show differences ☐
6.2 Fitting instructions are contained in the appropriate manual (Gyrolock or Swagelock). The manuals are held in the Electrical/Instrument Supervisor's office.	

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MODULE 1 - 6

	STRATEGIES	ASSESSMENT
1.0	Print and graphics showing the different flanges, gaskets and bolts	CML questions
1.1	Print describing how to identify the appropriate gaskets and flanges	CML questions
1.2	As above	CML questions
1.3	Print outlining methods of obtaining gaskets, blind flanges and spades	CML questions
1.4	Practical activity in which the trainee has to identify and obtain selected gaskets, bolts, blind flanges and spades	There will only be one Field Activity for this course covering 1.4 and 2.0 as shown. Field Activity in which the student will be required to identify and obtain the selected gaskets, bolts, blind flanges and spades.
2.0	Interactive Computer Based Training program (SIV) providing instruction for each step in pre-flanging job preparations including:	Interactive Computer Based Training program (SIV) providing assessment for each step in pre-flanging job preparations, 2.0, 2.1
2.1	Proving isolations and	Field Activity in which the student will be required to demonstrate the pre-flanging job preparation
2.2	Print describing the techniques to be used in minimising the amount of time that process pipework is open	CML questions
3.1	Interactive Computer Based Training program (SIV) providing instruction on how to safely commence unbolting the flange	Interactive Computer Based Training program (SIV) providing assessment.
3.2	Interactive Computer Based Training program (SIV) providing instruction on appropriate action when excess pressure in pipework is discovered	Interactive Computer Based Training program (SIV) providing assessment

RESOURCES

AUTHORITY G Colgrave

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MODULE 1 - 6

	STRATEGIES	ASSESSMENT
4.0	As per 4.1 ... on laying down a plastic sheet	Interactive Computer Based Training program (SIV) providing assessment
4.1	Interactive Computer Based Training program (SIV) providing instruction on the correct gasket removal technique. Text describing the process of gasket removal	
4.2	Interactive Computer Based Training program (SIV) providing instruction on the correct flange cleaning technique	Interactive Computer Based Training program (SIV) providing assessment
4.3	Interactive Computer Based Training program (SIV) providing instruction on the correct used gasket disposal procedure	Interactive Computer Based Training program (SIV) providing assessment
4.4	Interactive Computer Based Training program (SIV) providing instruction on the Asbestos disposal bin	Interactive Computer Based Training program (SIV) providing assessment
4.5	Interactive Computer Based Training program (SIV) providing instruction on how to safely install a new gasket.	Interactive Computer Based Training program (SIV) providing assessment
5.1	Interactive Computer Based Training program (SIV) providing instruction on how to carry out pre-flanging preparations	Interactive Computer Based Training program (SIV) providing assessment
5.2	Interactive Computer Based Training program (SIV) providing instruction on pre-tensioning techniques	Interactive Computer Based Training program (SIV) providing assessment
5.3	Interactive Computer Based Training program (SIV) providing instruction on tensioning techniques	Interactive Computer Based Training program (SIV) providing assessment

RESOURCES

AUTHORITY G Colgrave

DATE 26/02/92

Appendix A (v)

MODULE 1 - 6

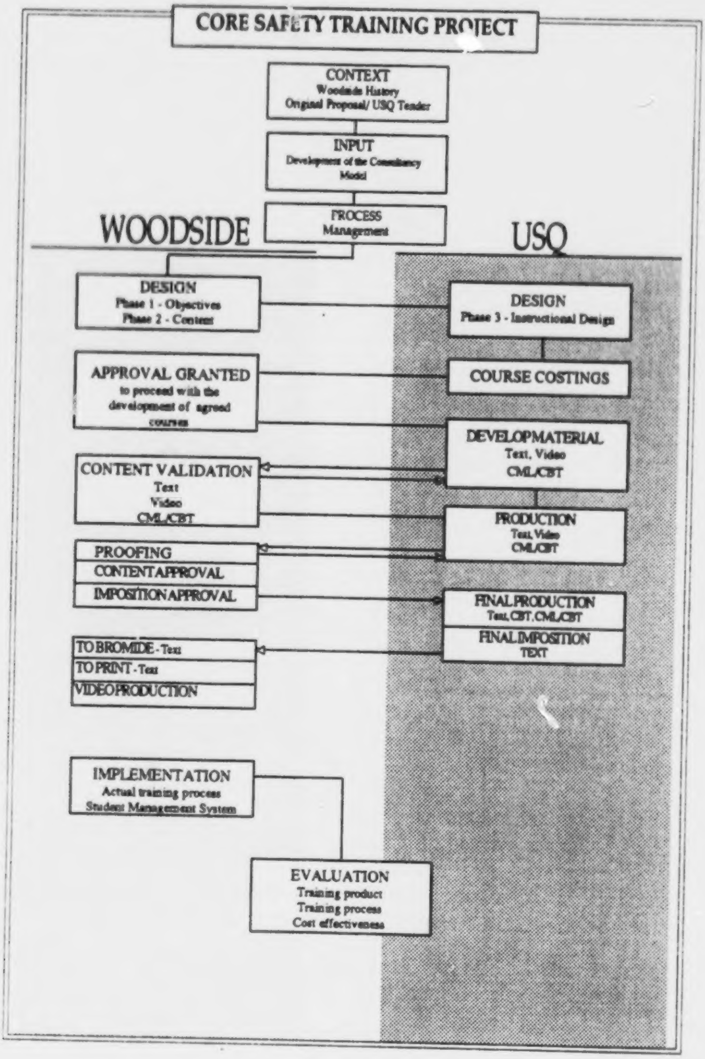
STRATEGIES	ASSESSMENT
6.1 Print describing appropriate replacement fittings (graphic)	CML questions
6.2 Print describing how to follow the manufacturers instructions for fitting fittings	CML questions

RESOURCES

AUTHORITY G. Colgrave

DATE 26/02/92

Appendix B


CORE SAFETY TRAINING PROJECT
CONTEXT
Woodside History
Original Proposal/ USQ Tender
INPUT
Development of the Competency Model
PROCESS
Management
WOODSIDE
USQ
DESIGN
Phase 1 - Objectives
Phase 2 - Content
DESIGN
Phase 3 - Instructional Design
APPROVAL GRANTED
to proceed with the development of agreed courses
COURSE COSTINGS
DEVELOPMATERIAL
Text, Video
CML/CBT
CONTENT VALIDATION
Text
Video
CML/CBT
PRODUCTION
Text, Video
CML/CBT
PROOFING
CONTENTAPPROVAL
IMPOSITIONAPPROVAL
FINALPRODUCTION
Text, CBT, CML/CBT
FINALIMPOSITION
TEXT
TO BROMIDE - Text
TO PRINT - Text
VIDEOPRODUCTION
IMPLEMENTATION
Actual training process
Student Management System
EVALUATION
Training product
Training process
Cost effectiveness

Appendix C

SAFE000250 Working in the Pilbara with Woodside
SAFE000251 Working in the North West with Woodside (NRA)
SAFE000252 Personal Health in the Pilbara
SAFE000253 Safety Everybody's Business
SAFE000262 Housekeeping
SAFE000264 Accident Reporting Techniques
SAFE000265 Accident Reporting Techniques (NRA)
SAFE000266 Basic Life Support
SAFE000267 Protect your body
SAFE000282 Continuity of Supply and Safety Agreement
SAFE000272 Vehicles
SAFE000283 Hearing Conservation
SAFE000284 Eye protection
SAFE000285 Personal Protective Equipment
SAFE000270 Hazardous Area Classification
SAFE000271 Working at Heights
SAFE000274 Electrical Isolations (IO)
SAFE000275 Electrical Isolations (SIO)
SAFE000276 Electrical Isolations (ESO)
SAFE000277 Electrical Isolations (SESO)
SAFE000278 Explosion Proof Techniques
SAFE000279 Chemical Hazards
SAFE000280 Process Sampling
SAFE000290 Process Isolations
SAFE000281 Asbestos and MMF Handling
SAFE000286 Portable Gas Analysers (NRA)
SAFE000287 Flanges Gaskets and Bolting Techniques
SAFE000288 Flanges Gaskets and Bolting Techniques (NRA)
SAFE000289 Portable Gas Monitors (NRA)
SAFE000302 Portable Gas Analysers
SAFE000291 Spring operate
SAFE000292 Materials Handling
SAFE000293 Personal Gas Monitors

SAFE000254 Permit to Work System (Plant)
SAFE000255 Permit to Work System (Supply Base)
SAFE000273 Permit to Work System (NRA)
SAFE000257 Site and Emergencies overview (Town Office)
SAFE000258 Site and Emergencies overview (Heliport)
SAFE000259 Site and Emergencies overview (Plant)
SAFE000260 Site and Emergencies overview (Supply Base)
SAFE000261 Site and Emergencies overview (NRA)
SAFE000268 Radio Communication Procedures
SAFE000269 Radio Communication Procedures (NRA)
SAFE000300 Working on the Jetty (Ops/Maint.)
SAFE000301 Working on the Jetty (GSO)
SAFE000304 Casing Handling Techniques
SAFE000305 Cargo Handling Procedures
SAFE000306 Use of steam cleaners
SAFE000308 Hydro testing facility
SAFE000309 Subsurface Safety Valve — N_2 test facility
SAFE000311 Introduction to Offshore Wireline Operations

Issues in the Development of Multimedia Courseware

Patricia Youngblood
University of New England, Northern Rivers

This paper describes a systematic approach to the design and development of interactive multimedia courseware for language learning. Critical management issues which affect the project's success at each stage of the development process are discussed. The complex nature of multimedia development is explored both in terms of the roles and responsibilities of team members as well as the interrelationships of activities at each stage of the development process, from analysis and design, through to development, implementation and evaluation. Recommendations for future development efforts include ensuring that adequate resources including time, money and staff expertise are provided, and that ultimate authority for team management is clearly vested in the project leader. In addition, the project leader's understanding of Instructional Systems Development methodology is stressed.

The purpose of this paper is to discuss management issues which are critical to the success of interactive multimedia courseware projects. These issues have emerged as significant events in the development of computer aided language learning (CALL) materials for a University course to be delivered in the distance learning mode. The author's perspective is that of instructional designer and project leader of a 5 person development team, which was established in the spring semester 1991. Some of the issues raised here are especially pertinent to large scale development projects which occur in academic settings.

The design and development of multimedia courseware is a complex process which requires the expertise of a range of professionals, including content specialists, graphic designers, audio-visual production specialists, computer programmers, and instructional designers, just to name a few. In addition, each of these professionals has their own ideas about education and training. Thus multimedia project leaders must be skilled in managing the interdependent tasks in the development process, as well as in facilitating a team effort. One of the most effective ways to manage this complexity is to use Instructional Systems Development (ISD) methodology.

The ISD model is applied by various authors to either macro or micro level design problems. At the macro level ISD is used to guide the development of complete instructional systems or training programs, while at the micro level it can be applied to the design of an individual lesson on a given topic. Accordingly, this leaves much room for variation in actual application, depending on the specifications of the individual project.

This paper presents issues that have emerged in the process of applying the ISD model to multimedia development. ISD was used to guide the design and development of computer aided language learning (CALL) courseware. (The CALL courseware described here can be classified as "multimedia" in that the final product incorporates a range of media, including text, graphics, animation, and sound.) ISD methodology was chosen to ensure high quality yet cost effective outcomes for each of the five stages in the development process--analysis, design, development, implementation and evaluation. While use of this methodology will not guarantee success, it is nevertheless a useful approach for multimedia materials where development costs are generally far greater than the production costs associated with the development of the component parts. Therefore, the following discussion will be presented in the context of the stages of the ISD model.

Stage One: Analysis

In the analysis stage the instructional designer must analyse the environment, or context in which the performance problem occurs. It is from this analysis that the designer derives the instructional goal. Thus the instructional designer's task is to translate a job performance problem into a realistic teaching or training goal, making note of the environmental constraints which will affect the design and implementation of the training solution. This is probably the most important stage in the development process. For projects in business and industry it usually involves a detailed needs assessment, including performance analysis, job task analysis, and prioritising identified training needs. The purpose of this phase, as Hannum and Hansen (1989, p30) explain, is "to determine how training can benefit society, an organisation, or a department within an organisation."

In the case of the CALL project described here, the performance or teaching problem had been identified by the Department of School Education--a shortage of secondary language teachers in the North Coast Region of NSW with the skills to teach Japanese. Moreover, many of the currently employed language teachers were (and still are) interested in extending their skills to include the teaching of Japanese, but they could not take time off work to attend a University course located in a distant city. Thus, they needed a University course, offered in the distance learning mode, and designed to match the secondary Japanese language curriculum guidelines in the New South Wales schools. Further investigation revealed that this shortage existed across the state of New South Wales and indeed across the country. Consequently, the target population for this course seemed to be potentially quite large.

Preliminary investigations into the feasibility of this project by upper level management at both the University of New England, Northern Rivers and the Department of School Education proposed that recent developments in computer technology, such as CD-ROM, be used to deliver the instruction. They hypothesised that the new technology had immense storage capability, as well as the ability to record speech and play it back. Moreover, they felt that the need for Japanese language instruction offered in a distance learning mode was so great, that the demand and thus the market value of the final product, would offset the initially high development costs.

It was in this early formative stage of the project that a thorough review of the literature on computer aided learning systems for teaching Japanese was commissioned. The reviewers, Claff, McNutt & Wilks (1989), found that language learning had proven to be a learning task well suited for computer aided learning. CALL programs in which digitised speech is used to provide a model of the native speaker's pronunciation, and which provide the learner with the ability to record his or her own voice were considered the most effective. (See Lian, 1991, for further details).

Thus, although the teaching or performance problem had been identified and the initial review of CALL programs was favourable, additional information about the learners and the environment in which they would be using the instructional materials was still needed. Therefore, the instructional designer proceeded to conduct an environment analysis, which is a particularly useful analysis for multimedia and CBT development in general. Tessmer (1991, p. 9) explains that environment analysis is "the analysis of the context in which the instructional product will be employed, of the physical and use factors of the instructional environment and its support environment." A detailed investigation of these factors, as described below, provided the rationale for later design decisions.

In this project, the focus of the environment analysis was on the target group and the way(s) in which they might use multimedia materials. The target group comprised teachers employed in secondary schools in the North Coast Region. These schools were supported by five educational resource centres (ERCs), which were geographically dispersed throughout the region, such that each school was no more than a one hour drive to its nearest ERC. While it was not realistic to expect every teacher to have a computer at home, the presence and location of these ERCs made it feasible to consider a multimedia solution to the training problem. The teachers could use a combination of printed workbooks, audiotapes and computer aided language learning (CALL) materials. The workbooks and tapes would be available to the teachers at all times and could be used at home, at work, in the car, or at the ERCs, wherever they chose to do their studies. On the other hand, the CALL lessons could be accessed on specially equipped computer workstations installed at each ERC. In fact, development decisions were later based on the assumption that an Apple Macintosh LC computer equipped with headphones, a microphone, voice recording software (Macrecorder), and an external drive (a 44 MB cartridge drive, and later CD-ROM drives) would be placed in each of the five ERCs in the region.

While the environment analysis had shown that computer delivery of course content was feasible, and the review of the literature supported CALL development, additional information on the specific learning requirements for the course was needed before the choice of instructional strategies could be finalised.

Thus, the output of the analysis stage in this project included the identification of the instructional goal or teaching/learning problem, the review of the literature on CALL, and the feasibility data from the environment analysis. This information contributed to the important design decisions which had to be addressed in Stage Two of the development process.

Stage Two: Design

In the Design Stage, broad goals derived from the needs assessment data are translated into education and training goals, which are in turn translated into measurable learning objectives.

In this project, the broad learning goal was to create instruction which fostered a communicative approach. This approach includes the ability to read and write words, phrases and sentences in all three Japanese scripts (Hiragana, Katakana and Kanji), as well as to communicate orally (i.e. to develop speaking and listening skills) in Japanese. These requirements along with the data collected in the analysis stage led to the selection of interactive multimedia as the best medium to achieve the learning goals. Multimedia, with options of playing and recording digitised speech, displaying high quality graphic images (including some animation), and offering a variety of text options for showing both Japanese script and the English equivalent, seemed to satisfy all learning requirements with the exception of the writing function, which easily could be addressed in the accompanying print materials. The next step was to consider lesson design options for the multimedia materials.

A critical issue for instructional designers at this stage is to explore innovative ways of delivering the content. This is especially true for the design of CAL and multimedia materials. Because instructional designers are skilled in instructional analysis, or breaking down more complex learning tasks into smaller subtasks and translating these subtasks into behavioural objectives, it is tempting to then design an instructional sequence which provides for step by step mastery of these subtasks. However, this approach can result in boring, linear programs in which the emphasis is on mastery of isolated skills rather than the synthesis of skills, or application level learning.

A better alternative is to experiment with more dynamic designs, which can be programmed in a prototype version and trialed with learners from the target audience. Tripp and Bichelmeyer (1990, p 38) suggest that instructional designers use the software design methodology of "rapid prototyping" to experiment with new ways to facilitate learning with CBT and multimedia materials. These authors recommend this approach be used whenever designers are working with development tools that offer both modularity and plasticity (computer software such as HyperCard, for example). Moreover, they suggest it is a useful approach in "new situations where there is not an abundance of experience from which to draw." It is also extremely valuable in situations where development costs are high, as in the production of multimedia materials.

For all of these reasons, a prototype CALL program was created in the early days of this project, using HyperCard as the development tool. The design team produced an interactive learning environment in which learner control was preferred over system control, and learners had the opportunity to explore a number of different paths through the program. In addition, a number of different modes including tutorial, drill and games, for example, were incorporated into the one CALL package. It was subsequently trialed with teachers from the target audience. As a result, considerable changes in the design were made prior to commencing full scale development of the CALL component of the course. Thus rapid prototyping afforded the opportunity to experiment with a new design and to collect valuable data on its effectiveness prior to full scale development.

Stage Three: Development

In multimedia development, this is the stage in which the instructional materials are written and produced. Because development is truly a team effort, the most important issues in this stage are centred around team selection and management.

In the development stage, the contributions of each team member must be monitored and carefully coordinated with the work of the other members. Therefore, the appointment of a skilled project manager is critical to the success of the project. As Hannum & Hansen (1989) explain,

> Effective instructional systems development projects require careful management throughout the whole process. Without such careful oversight and coordination, projects fail. Some of the needs for management are not at all unique to ISD projects; any time there is a group of people working on a variety of tasks over time, there is likely a need for management. When the tasks are interdependent, as in instructional systems development projects, then the need for management is even greater (p. 157).

In his book *Computer Based Training: A Handbook for Training Professionals,* Sims (1991) explains that the duties of the project manager include negotiating with upper level managers and clients to define the scope of the project , developing standards, identifying potential problem areas, procuring funding, setting up the project team and making appropriate work assignments. Of these duties, one of the most important is the selection of team members. Because multimedia development requires many different kinds of expertise, the manager must consider whether s/he will hire new people, train existing staff, deploy trained staff from other departments, or retain consultants. In some cases one person will have expertise in more than one area, but the manager must decide which skills are needed at what time and make the appropriate work assignments. When roles and responsibilities for team members are clearly identified at the outset, and a climate of mutual respect and open communication is established, then the potential for interpersonal conflict among team members is greatly reduced. Nevertheless, new team members must be briefed on the interdependent nature and resulting pressures of working on a development team.

In the CALL development project described here, the team members included the instructional designer and project manager, a full time course writer (content specialist), a full time graphic artist, two full time computer programmers, and part time contract help to assist with word processing and the audio recording of native speakers. The course writer and graphic artist were hired for their skills in each of these areas, while the computer programmers were deployed from another part of the organisation and trained in the use of the authoring system that was used. The instructional designer/project leader was the only team member who had worked on a CBT or multimedia development team previously. Therefore, a considerable amount of time was needed in the beginning of the development stage to orient team members to their job tasks.

As noted above, the instructional designer on the CALL project also served as the project manager. There were advantages and disadvantages to this arrangement. However, Hannum & Hansen (1989) suggest that instructional designers have the necessary education and design skills, as well as familiarity with a range of media to manage the development process. These authors believe that instructional designers, and not content specialists, should direct ISD projects.

> It is essential to the success of a project that the designer have the required authority and leverage to make ISD decisions; that is, decisions driven by

> instructional principles. Of course, content persons and ISD specialists can discuss how to go about some task, like whether to use lecture or computer based training to teach a certain objective. However, when it is time to make the decision and move forward, someone must be empowered to say 'This is the way it is going to be.' That person should be a skilled designer, not a content person. Rarely is there time for content persons to learn enough about ISD to function in this role (p 158).

This author has noted that in tertiary institutions in Australia, this is often not the case. It seems that it is often the academic content specialist who has the final word in design decisions.

Thus, it is imperative that the project manager not only have the authority to make design and development decisions, but s/he must also have adequate resources to complete the job on time and within budget. These resources include sufficient allocation of staff time to work on the project. One of the difficulties which persisted throughout the first year of development in the CALL project described here was the restriction on staff resources imposed by management which limited the instructional designer/project leader's involvement in the project to only 50% of her time.

Sims (1990, p 49) explains that it is the project manager's responsibility to ensure that "resources are available when required, and to obtain additional resources if required." He further notes some of the difficulties in estimating time and resources required for development tasks. The author (Sims, 1990, p 49) explains that the manager must realise that "an activity which is estimated to take one author 40 hours to complete will not necessarily be halved if two authors are allocated to the same activity." This was an assumption which was made in the CALL project described here. Two programmers were assigned to the project to speed up the development process. However, the resulting complications with job task allocations, additional computer hardware and software needs, and other procedural details did not result in a significant reduction in development time. In fact, periodic imbalances in the work flow could be attributed in part to this team arrangement.

To summarise, Hannum & Hansen (1989) identify a number of ways in which ISD projects can "go astray."

> When there is an adequate staff following an acceptable model in completing an ISD project the remaining area associated with failure is inadequate management. If resources are not made available or are misused, if schedules are not kept, if the quality of the output from each step in an ISD model is not monitored, if effective communications are not the norm, or if a spirit of mutual respect and cooperation among the staff is missing, instructional systems development projects can go astray and be very unproductive (p 159).

These authors (Hannum & Hansen, 1989) suggest that project managers must pay particular attention to two areas: (1) project management and control, and (2) consulting/negotiating tasks. In the first area, the manager must be able to estimate the amount of time and resources needed to complete each step of the ISD process, to schedule the work necessary to complete the project, and to monitor the work and make necessary adjustments so the project can be completed on time and within budget. In the second area, the manager must be able to establish and maintain smooth working relationships among the team members. It is perhaps worth emphasising that in addition to expertise in the skills required for design and development work, the criteria for team membership must include good communication skills and an ability to work well as a member of a team. These are words often seen in job advertisements, but they describe a quality which is quite difficult for the project manager to assess ahead of time.

The next two stages in the development process, implementation and evaluation, have not officially begun in the CALL project described here. However, some issues related to each of these stages have been identified by the project manager in anticipation of work required in these areas. Thus, overlap in the stages of the ISD model is an issue that future project leaders must be prepared to address.

Stage Four: Implementation

In the implementation stage, the training is actually conducted. The instructional materials which were developed in the previous stage are used with the learners from the target audience. In larger scale projects, a pilot program is implemented and formatively evaluated before full implementation occurs. In multimedia development, it is extremely important to implement in stages, evaluating the product at each stage to identify necessary changes as early as possible. Because media production costs are high, reviews should be conducted and changes made prior to producing studio quality sound recordings, shooting video, or pressing a CD-ROM or videodisc.

In the CALL project, studio recording sessions with native speakers were conducted only twice in the first 12 months of the project. For the rest of the time, draft quality recordings were made by the course writer and incorporated into the courseware by the programmers. Similarly, the programmers authored the courseware on computers and saved copies of the courseware on external cartridges, which could be easily updated. These cartridges would be used in the first stage of implementation, so changes could be made prior to pressing a CD-ROM disk.

Another consideration in developing materials in an academic setting for tertiary courses is the conflicting roles of the content specialist during implementation. If the content specialist is a full time faculty member, his or her time for development work (i.e. writing and advising on media integration) will very likely be quite limited. However, an advantage is that this person will have a better understanding of how the new material relates to material in other courses offered in the Department, as well as an understanding of the procedural and assessment requirements that must be addressed when implementing these materials in a University course. On the other hand, even when the content specialist has been hired as a full time team member, complications arise when s/he is needed for full time development work in the development stage, as well as for assistance with the implementation and evaluation activities. Because in most cases, multimedia development work on the next set of materials will continue while the implementation and evaluation of the first set of materials is taking place. It is best to address these problems in the early stages of team selection and orientation, rather than waiting to find additional content specialist help at the implementation and evaluation stages.

Stage Five: Evaluation

The final stage of the development process is the evaluation stage, which includes both formative and summative evaluation of the materials and an evaluation of the development process itself. However, as noted above, formative evaluation occurs to some degree in each of the earlier stages in the development process. If a prototype was produced in the design phase, it should have been evaluated. Similarly, as noted above, the initial implementation and evaluation of the first lesson or set of lessons may occur simultaneously with the development of the second set of materials.

Sims (1990) suggests that project managers must consider the following questions to guide the management of evaluation efforts:

> What will be evaluated?
>
> How will evaluators communicate their comments?
>
> When do evaluations need to take place? and
>
> What is the process for making revisions? (p 76)

In addition, the manager must decide who will conduct the evaluations--an external reviewer/content specialist? an external instructional designer? an external computer specialist? the client or customer? a member of the target audience? Each of these individuals' perspectives will provide valuable evaluation data.

Once the evaluation data is collected, the project manager must consider all recommendations and other factors, then decide which aspects of the program to revise. As Sims (1990) explains, the manager must determine "which evaluation comments indicate problems in the courseware, prioritize those problems and make revision decisions, ensuring that staff are available to make the specified revisions. The extent to which revisions can be implemented will depend on the impact on the project completion date (p. 76)."

In the CALL project described here, revision decisions had to be made continuously. As a guiding principle, the evaluation data from the learners should dictate which changes are absolutely necessary. However, many revisions must be made prior to the evaluation stage. The iterative nature of the development process necessitates revising earlier efforts. In fact, the project manager is evaluating the quality of the product continuously, as s/he monitors the work of the team. However, it can become a sensitive issue for team members who have revised the same material several times already and feel that any further changes are a waste of their time. Therefore, these quality control decisions must be made in light of any negative effects they may have on team morale.

Conclusion

In conclusion, this paper presented some of the management issues which are critical to the success of large scale multimedia development projects. These included an analysis of the environment in which the materials will be used, the advantages of rapid prototyping in the design stage, the importance of team selection and management during all stages, and the dilemma of revision decisions which also occurs in all stages of the development process.

Instructional Systems Development methodology was proposed as a useful tool to guide the development process. In addition, the complex nature of multimedia development was explored. Two factors which contribute to this complexity are the interdependencies among team members, and the interdependencies, or overlap, in the activities which occur in each of the five stages of the ISD model.

Thus successful multimedia development projects are those in which the project manager is skilled in Instructional Systems Design methodology, where adequate resources have been allocated so the project can be completed on time and within budget, and where ultimate authority for team management has been clearly vested in the project leader.

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Yes, I did do it on repurpose!

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Sayre and Montgomery (1991), of the Telecommunications Development Center at the University of Minnesota said, "Throughout the 1980's, interactive videodisc was hailed as a powerful tool for solving many educational problems". They noted that the cost of videodisc production and delivery systems have greatly restricted its application. They received funding to undertake a research project to investigate low-cost alternatives to videodisc production and implementation. The project focused on investigating the benefits and limitations of repurposing existing videodiscs for use on low-cost hardware systems.

My paper examines the concept of repurposing laser videodiscs and using them in a technical and further education institution. A trial is planned at the Learning Resource Centre, Gilles Plains College of TAFE, in Adelaide, South Australia of a number of videodiscs produced by institutions in the United States, and attempts will be made to repurpose these discs for use in learning delivery in the School of Para Dental Studies and the Para Veterinary Unit of the School of General Studies.

In the year of Columbus, 1992 when America and Spain re-examine the discovery of the America's by Christopher Columbus, there is also a rediscovery of the medium of videodisc. IBM have commenced a project called Columbus: Discovery and Beyond which appears to be a hypermedia environment product (or perhaps cynically just hype), which will incorporate both CD-ROMs and videodiscs.

Mark (1991) reported that in 1991 there were an estimated 1800 educational videodiscs available with a further 800 titles to appear in 1992. Other criticisms have been because of the costs of developing discs.

Workers at Auburn University in the United States said:

> Interactive video technology tends to encourage us to 'think big'. When we learn of possibilities like multiple branching designs, touchscreen, stillframe audio and all the bells and whistles, we begin dreaming of producing such complex and sophisticated courseware ourselves. We may spend so much time dreaming that we forget about simple designs that we might actually implement under existing budgetary constraints. (Branch et al, 1987)

These workers also saw that the concept of a consortium approach had much merit to develop, evaluate and distribute interactive video lessons. The consortium approach allows the sharing of the expertise of instructional designers, video production staff, computer specialists and the cost of expensive equipment. They also saw the use of interactive video technology as allowing students access in their setting, a veterinary science school, to abnormal animals not always available when needed. These two themes, that is the consortium approach and the access to 'patients' or situations at the time the students require are themes repeated often in the literature.

In 1991, the School of General Studies of Gilles Plains College of TAFE, received funding for a pilot project to investigate the use of a commercial software package developed by IBM called Principles of the Alphabet Literacy System. This software at that time ran on the IBM platform using the InfoWindows environment, touch screens and laser videodiscs (it now is available on CD-Rom). It was successfully trialed with adult basic education students, including people from a Non English Speaking Background. During discussions with David Hale, a consultant with that project, this author learnt of the existence in the United States of a consortium of veterinary educational institutions called CONVINCE as well as work being done at the University of Kentucky in the dental education area.

Several attempts were made in 1991 to contact staff at the University of Kentucky to enquire about access to their materials. In late December we received a copy for trial of the laservideo disc, "The Anatomical Features of the Permanent Dentition". We found the disc of interest but needed the software to trial the disc. The most expedient method to communicate was to telephone Eric Spohn, Professor of Dental Education. This was done and has resulted in a great spin-off effect. During our discussion enquiry was made about similar work with laser videodisc and contact names were provided.

We contacted Lyn Johnson of the University of Iowa and Professor James Craig of the Dental School, of the University of Maryland at Baltimore We have now found that they are the leading developers of interactive laser videodiscs for dental education.

Laserdisc technology has great storage capacity — for example one of the veterinary discs we have identified has 23,000 slide images of veterinary pathology; a dental disc has 33,000 slide images as well as video and audio. The prices we have been quoted make the discs well worth while purchasing just as repositories of images. However their use as they stand, with supporting software, supplied by the developers as self-paced/open learning materials would also appear to have great value. Adding to this we have the opportunity to develop these stores of visual images into our own learning materials through the use of Authorware and HyperCard and the use of the recently released system software from Apple 'QuickTime'. (In virtually all cases, the developers of the laserdiscs have invited us to 'repurpose' their discs.)

Curriculum will increasingly be delivered through electronic media in the future, and students will use computers extensively during their education and throughout their careers. Increasing proportions of learning will focus on problem-solving tutorials and lectures will decrease.

Computer learning environments must be highly interactive and provide for the natural progression of inquiry and feedback for learning to occur. The use of optical disc technology and simulations can allow this to occur. Siegel (1990) said "...the unique contributions made by this form of instruction is that it enables students and staff to diagnose and manage conditions that they might not otherwise be exposed to because of the rarity of the disorder or inadequacies within a given patient population, and without threat of bodily harm".

In another article, researchers said that "students enjoyed the opportunity to practise diagnosis and treatment planning for multiple patients in much less time than is necessary clinically. The students ... predict that the simulations will help develop their clinical diagnosis, treatment planning, and problem solving skills systematically".

This line of thought was also taken up in the Australian context by Baker and Ziviani (1986) who said, quoting the work of Gayeski and Williams (1984), "...the power of interactive video to simulate conditions which are rare, dangerous, distant or otherwise difficult for students or researchers to encounter is one of its most significant attractions".

Brandt (1986) suggested from a literature review as a student paper as long ago as 1986 listed 10 situations where interactive video should be considered as a delivery system:

1 To gather together a large collection of multimedia material such a slides or a mixture of slides and motion sequences on film and video.
2 A large number of learners are distributed over time and place.
3 Teachers with subject matter expertise are in short supply.
4 Equipment simulation is required.
5 Simulation of a potentially dangerous situation is required.
6 The situation requires continuous practise and or retraining.
7 The subject matter is relatively stable.
8 The training involves the teaching of processes, procedures, problem solving, and decision making.
9 Learners vary in experience and/or entry level skills.
10 There has to be a better way.

We have currently a research proposal for funding to examine discs produced in North America.

Project Outline

This project will examine and trial a number of laser video discs produced in the United States of America to determine their validity for use in South Australia. The project leader has identified a number of videodiscs developed in the USA. and has been encouraged by the response from lecturing staff in the disciplines at Gilles Plains College of TAFE.

We believe we can access and use the work of a number of overseas bodies. They include a veterinary consortium, CONVINCE made up of 31 academic institutions in Canada and the United States, a dental consortium, COMMITTED (the Consortium on Multimedia Information Technology to Enrich Dentistry) and at least one commercial supplier, VIDEODISCOVERY in Seattle, Washington.

The project objectives are as follows:

1 To assess student reactions to interactive technology as a means of learning.
2 To investigate the effectiveness of teaching students through interactive simulations.

3 To provide advise to other TAFE staff on the suitability of interactive platforms for delivery of learning.

4 To examine the use of barcode technology in learning materials.

Gilles Plains has a number of teaching programs unique to South Australian TAFE and, in the case of dental hygiene, unique to Australia. We have the opportunity to provide a national centre of excellence for retraining and updating in the para professional fields of veterinary nursing and dental hygiene using learning materials produced by overseas institutions.

The intent of the project currently with the working title of "Seeing the Light" is to use the discs in two ways.

1 The first is to use the laserdiscs as originally developed with supporting computer based software and in the case of one package with a number of simulations. (Simulations provide student exposure to patients that are not readily or conveniently available during clinical experiences. Simulations provide clinical and radiological images and require the student to investigate the patient's previous medical and dental histories and the present complaint. This produces "realistic" patient experiences.)

2. The second use is to 'repurpose' the visual information stored on the videodiscs to develop our own learning materials, including print, videotape, and computer based materials such as Authorware and HyperCard packages.

We believe we can enhance dramatically our delivery methodology in our current and planned courses including Traineeships as well as allowing us to develop new learning materials for new training and retraining initiatives.

The opportunity exists for example in the dental hygiene area for retraining of dental hygienists and other dental staff using computer simulations of patient's suffering from current 'health crisis diseases' as AIDS, herpes. Upwards of 300 simulations are being developed in North America. This sort of training lends itself to the self-paced competency based curriculum to which our courses are moving.

Even the entry competencies of basic reading skills, particularly for English as a Second Language, and Adult Basic Education can be met, using this technology, the PALs project at Gilles Plains has demonstrated this. Another follow on disc, SKILLPAC, uses workplace contexts such as phone use, reading first aid manuals, interpreting invoices, to improve basic communication skills in language, listening, reading, writing, maths, and problem solving — all skills referred to by Mayer and others like, Carmichael and Finn, whose voices are now being heard in education and training.

As a parallel project, an undergraduate student of the School of Library and Information Management, Anthea Duthie, is undertaking an annotated bibliography of laserdisc and CD-Rom technology and she will prepare a handbook to the area describing the possible uses, the different types of discs and hardware environment required. There appear to be 1000's of discs available yet their use in Australia is quite low.

Cheetham (1988) noted that:

> Videodisc as a medium almost died before it existed. The only advantage that it had over videotape was that it had random access of sections of the disc and could hold frames in still motion without damage to the disc or the equipment. Videodisc is able to hold all types of media; film, video, slides, graphics, audio and computer data.
>
> However, interactive videodisc combines the resources of videodisc with the ability of the computer to operate the disc.

Others have avoided videodisc because of the cost of the hardware. O'Neil (1988) commented:

> However, a note of warning should be sounded, as at least two problems exist. The first is that the videodisc is basically a single user system. The second factor is that of cost. Although it is good value for money, as a single user system it is beyond the budget of schools to buy in the numbers required for efficient class usage.

To argue against the concept of the videodisc system as a single user device we could consider a number of strategies for its use.

Lookcatch (1989) provides some useful insights. He was writing in a training concept but I feel that his arguments are valid for a further education setting. It can be used in a small group situation which can provide for debate and group interaction; group presentation is simple to schedule, and in many cases is more cost effective than individual learning settings. Its use by pairs of learners rather than individuals also provides advantages — two students working together require half the time it would take them individually. A very positive learning strategy mentioned was that working in pairs (or as Lookcatch put it — cooperative learning) facilitates learning through discussion — discussion of course related issues with another contributes to more thorough comprehension. Students have reported that the discussions themselves are significant learning opportunities.

Aker and Gordon (1986) suggested after a study which examined the application of "group use" videodisc, that small group and individualised approaches must be combined to optimise the educational process. They found that whilst students found the technology easy to use and the group process valuable in examining the material available they preferred to work with others rather than alone with the machine. Faculty perceived the group approach as more consistent, a better use of class time and a more efficient use of financial resources when contrasted with individualised instruction. The point has been made to arrange trials of learning settings to ensure the best solution — sound advice!

Milheim and Evans (1987) also examined group instruction using interactive video and they stated that many students simply learn better in a group instructional setting where interaction with others can be very stimulating and that the different experiences of various students. They also suggested the obvious cost benefits of not needing expensive duplication of equipment and the costs of new learning spaces can also enrich the learning situation. Other criticisms have been because of the costs of developing discs.

Ebert-Zawasky and Abegg (1990) used students successfully to develop lessons from generic videodisc material. This author wishes to examine this technique in his own institution as costs can be reduced, and students appear to benefit from producing their own learning materials.

Blanto, Robin and Kinzie (1991), graduate students at the University of Virginia, found that they could inexpensively repurpose a feature film on videodisc, using a Macintosh computer with HyperCard and a Pioneer videodisc player. Their paper provides good suggestions for "repurposing".

Sayre and Montgomery (1991) in their study indicated that repurposing existing materials consisted of three initial stages. These were:

1 Videodisc Review: That is the locating of materials. This author has certainly found that it is not at all easy and has learnt that others have had similar frustration. A major problem is that much educational material is produced in education institutions but is not commercially available, nor listed.
2 Videodisc Documentation: We could refer to this as "shot-listing" or providing a map of the disc. This is very time consuming but very essential and must be thorough and accurate. I have found disks with no frame listing available as well as disks with very good documentation.
3 Program Design: We could refer to this process as reverse storyboarding as we identify existing material, then storyboard the applicable frames, and then use instructional design to work within the constraints imposed by the material available.

Sayre and Montgomery suggested in their report that by repurposing a dedicated disc to achieve objectives similar to those of the original design, the instructional designer can obtain the maximum flexibility with the least amount of work. They also said that generic discs, although having the advantage of being widely applicable, require more work. A caution was offered by these workers who said:

> Even with best case scenarios, repurposing remains a compromise because of design restrictions it inherently imposes. Success is dependent primarily upon three variables: the availability of applicable material, the budget, and the designer's creativity.

The notion of repurposing videodiscs has been addressed by workers in Australia, Baker and Ziviani (1986), who said:

> It is worthwhile noting that programs can be produced to access useful frames and sequences on existing discs, and that the same videodisc can be used for initial presentation as well as the review system. The system is not limited to undergraduate training. Refresher studies and distance education both stand to benefit greatly.

The notion of refresher studies or professional update was a key issue identified by Keller (1989), who prefaced his thoughts with a quote from Bruner (1966) before outlining five reasons for impetus for change in instructional delivery. Because of its insight I will repeat his quote here:

> Man's use of mind is dependent upon his ability to develop and use tools or instruments or technologies that make it possible to express and amplify his

> powers. It was consequent upon the development of bipedalism and the use of spontaneous pebble tools that man's brain and particularly the cortex developed.
>
> It was not a large-brained hominid that developed the technical- social life of the human; rather it was the tool-using, cooperative pattern that gradually changed man's morphology by favoring the survival of those who could link themselves with tool systems and disfavoring those who tried to go it on big jaws, heavy dentition, or superior weight.

Keller's article discussed the CONVINCE veterinary medicine consortium. He outlined four benefits of interactive videodisc systems. These were that there is:

1. Active or learner controlled involvement in the learning process.
2. An individualised pace at which one can work in the interest of skill development, reviewing clinical procedures and basic science matter, and participating in scored practise to assess her/his skills.
3. No limit to the number of PCs on line.
4. When combined with satellite, microwave, cable and computer technologies it is possible to have widely placed personnel and centers take part in teleconferencing.

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Interface-Lift: Elective Or Compulsory?

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When it comes to interface design, developers of educational software applications often debate whether or not aesthetics and visual communication are as important as functionality and useability. This paper argues that because all of these features play an integral role in design of the interface, the development teams should either include a graphic designer who is versed in the nuances of information design, or plan to master the techniques of visual communication themselves. There are many available resources with which to address this very issue. However, most of these are rule-based; the developer is instructed passively to follow a specific set of guidelines. Although such information is useful, it deters the developer from assimilating knowledge actively in ways that encourage decisions based on both creativity and competency. In other words, thus far developers have relied on an outdated learning model. Moreover, this model undercuts the philosophy behind educational technology, and this leads to the development of powerful applications that are either under used or are discounted because the interface is at best lacklustre or worse — deceptive.

One remedy for this situation is to first examine, then modify and, finally to apply the principles governing the vocabulary of vision to interface design. The vocabulary of vision is composed of fundamental design concepts adapted from the rich tradition of fine art and design. These design concepts serve as the intermediaries between abstract theory and concrete, rule-based learning. Armed with the concepts governing good design, a developer will be able to apply this knowledge when faced with design decision-making, instead of blindly following prescribed rules. As an active participant in the design process — involving both the functionality and aesthetics of the interface — the developer will enhance the useability and markedly improve the visual quality of the software.

The Interface

The interface is the window into the computer system that tracks and facilitates communication between user and machine. Tufte (1989) maintains that the interface reflects the physical properties of the system, the functions to be performed, and the balance of power and control. It determines what customers, reviewers, and users think of the software. He states "Today the competition is at the interface" (n.p.). The following ten objectives of a well-designed interface have been distilled from the following sources: Apple Computer, Inc. (1989), Donoho, Donoho, Gasko (1988), Erickson (1990), Hicks & Essinger (1991), Hedberg & Harper (1990), Kay (1990), Marcus (1992), Mountford (1990), Nelson (1990), Norman (1988 and 1990), Semper (1990), Tufte (1989 and 1990), and Vertelney, Arent, Liberian (1990). (Complete citations appear in the bibliography.)

Objectives for well designed interfaces

1. Visual clarity

Clarity in the design of both visual elements and in visual cues shortens data search time. In contrast, conflicting colours, illegible text, cluttered layout, ambiguous coding and hierarchies, and inadequate spatial relationships affect perception negatively. Impaired perception caused by poor design reduces user performance because of such phenomena as lack of concentration, fatigue, stress, and irritation (Hicks & Essinger, 1991). Well-designed software uses constant context switches that force the user to remember things seen in one view in order to use other views more effectively. The frequency and clarity of the visual cues, reduce the user's dependency on memory. Dermot Browne, one of Britain's leading experts on human-computer interaction points out that cognitive scientists suggest that recall for information represented visually is greater than that for written and verbal information (cited in Hicks & Essinger, 1991). He continues "It is known that memory capacity is strictly finite, so not only does a heavy burden on working memory tend to exhaust the user mentally, it is also likely to prevent him from effective use of working memory at other stages in the interactive process" (quoted in Hicks & Essinger, 1991, p. 25).

2. Consistency

Consistency in the use of visual elements, tools, commands, operations, and organisational style, is the foundation of good interface design. Consistency also is effective in reducing memory load. Knowing what type of information will be covered and when and where it will appear builds predictability into the software application. Careful attention to detail in the design and flow of the interface promotes consistency. Standardised interface conventions can also be applied. Although they sometimes lack aesthetic quality, these conventions are easily recognised, and so, they reinforce consistency through familiarity.

3. Good mappings

There should be clear relationships between the user's actions and the machine's responses, the controls and their effects, and the state of the system and the interface. The structure of the learning experience should be apparent.

4. Feedback

Ideally, the user should receive immediate, full and continuous feedback concerning the results of all self-initiated and program-driven actions. This promotes a sense of progress. Feedback can take the form of written, visual and/or auditory responses.

5. An easily grasped metaphor or concept

Mountford (1990, p. 25) describes the metaphor as "powerful verbal and semantic tool for conveying both superficial and conceptual similarities between familiar and novel situations." Learned associations should mould the metaphor because these familiar experiences help users to grasp complex ideas. Distinct visual and auditory cues, as well as the associated vocabulary, enhance the meaning of the metaphor. Ian Cowles, a consultant for human-computer interaction, (cited in Hicks & Essinger, 1991) recognises metaphors as being abstract, even magical, as well as concrete. The beauty of a metaphor is that it can amplify what it represents.

Although the use of a metaphor is the norm in interface design, some applications are compromised or even impaired by having to adhere to such rigid conventions. To be effective, that is, to spur creativity rather than inhibit it, metaphors require that every function conform. A more flexible alternative to the metaphor is the development of a unifying concept. A concept might be derivative of a story line, a particular theme, or a stylised look. Kay (1990, p. 199) contends "... that *metaphor* is a poor metaphor for what needs to be done." His group at Xerox PARC coined the phrase "user illusion," a term that incorporates stage, theatrics and magic in its composite.

6. Efficient navigation schema
Users should be able to find out where they are quickly, and how to get back to where they were, in what Florin (1990) refers to as "the information landscape." Navigation tools include: directional devices, maps, headings, visual effects, timelines, on-line help, user guidance facilities and sound cues. Hedberg and Harper (1990, p. 267) explain that a user can be easily confused because in complex interactive environments, there are multiple paths to the same or different end-points. "Navigation systems can facilitate the understanding of students learning sequence and reduce the problems of poor learning schema development."

7. System transparency
The interface should be transparent, concealing the complexity of the system so that the user can focus on the tasks, rather than on the tool. Tufte (1989, n.p.) contends that the attention should be on the data, rather than the "data container." In an educational setting, learners should be intrigued with what they have learned, rather than with the hardware and software through which they learn.

8. Data organisation
Psychologically, a user needs to get closure on one stage of the interactive process in order to move on to the next. This is accomplished by grouping information into readily digestible units. For example, tasks might be divided into a series of attained closures, or the information might be layered and separated using visual techniques. Visually stratifying various layers of information reduces noise and enriches the content of the display. Information should be clearly and succinctly organised, and copy and content should take into account the inherent characteristics of the screen.

9. Interactivity
An active, participatory interface allows the users to control the learning environment by directly manipulating materials. Ultimately, the user, working at his or her own pace, will learn more and have better recall. Interactivity is challenging and inspires the user to respond more creatively. Learning is supported through exploration. In an effective interactive relationship the user's actions should be cost free and reversible.

10. Evaluation
User evaluation is essential at regular intervals of the design process. Demographics, cultural values, working environment, and level of expertise of the user all need to be thoroughly researched before an interface design can be fully implemented. Even though developers are encouraged to design from the user's point of view, the product should still be tested on projected users. Cowles (quoted in Hicks & Essinger, 1991, pp. 32-33) says an interface designer can best assess what is likely to prove most acceptable to the user "by sitting down next to users as they work with a computer system and by seeing what they find easy and what they find difficult, and what they like to do and what they don't like to do ... There's no point in conducting this type of observation exercise unless you have the courage to accept that you were wrong, swallow your pride and start again." User evaluation, combined with feedback from

content specialists and colleagues, keeps the developer on track. By this process, the developer is more likely to avoid indulging novelty, marketability, and a need to please the client when in fact the user is the major constituent.

A New Genre

In the past, interface design was under the jurisdiction of the computer-related disciplines for which programmers wrote the code and produced the software applications. With the advent of the new genre of user-oriented authoring tools (exemplified by *HyperCard* for Apple Computer's Macintosh environment) almost anyone with an idea, some rudimentary skills, and access to a personal computer can develop an application. Moreover, every one of these "new programmers" is needy of the expertise visual skills and talent required to develop and implement effective interface design.

Because the impact of interface design is so broad, it comes under the jurisdiction of many disciplines including: computer science, engineering, cognitive science, business, psychology, education, industrial design and visual design. Current research confirms that interface design is composed of three basic components: 1. Functionality; 2. Useability; 3. Visual communication and aesthetics. Functionality describes how the program operates. Useability defines ease of use. Visual communication and aesthetics refer to the overall style, and visual translation and positioning of information.

Functionality first: Aesthetics later?

Much of the literature on interface design claims that functionality and useability are independent of, and more important than, visual communication and aesthetics. Apple Computer's own *HyperCard Stack Design Guidelines* (1989, p. 8) maintains that "User interface encompasses all the elements that determine how a stack looks and how a user interacts with it, such as presentation, graphic design, and navigation. It does not include that stack's basic functionality." The term Graphical User Interface (GUI) has been coined to specifically describe the visual qualities of an interface. This term further isolates the visual attributes of the interface by claiming that they are separate entities.

The separation of the graphic-based qualities and the functional aspects is difficult. How can the visual elements be distinguished from the functional elements of the operating system in a highly evolved graphic interface like that of Apple Computer's Macintosh? Even the presentation of a simple paragraph of text requires making decisions that are graphically motivated. What typeface is most effective? Which style, weight, size and colour of type are appropriate? Should it be set upper or lower case? How much letter spacing, word spacing, and leading should be applied? What line width works best, and how should it be aligned and positioned? Therefore, for the purpose of this paper interface design will refer to an application's functionality, useability, *and visual communication and aesthetic properties.*

Interface design is often treated as an afterthought in software development. Don Norman (quoted in an interview with Rheingold, 1990, p. 6) complains that "It implies you already have done all the rest and now you want to patch it up to make it pretty for the user." Kay (1990, p. 191) agrees "Many are just now discovering that user interface is not a sandwich spread — applying the Macintosh style to poorly designed applications and machines is like trying to put Béarnaise sauce on a hot-dog!" Padraig Caravan, Project Manager in charge of IBM Educational Television, sums it up nicely.

> ... Useability is absolutely central to any technology and without useability technology can bring us no benefits. Computer technology makes special demands on user interface designers because the very nature of computers means that they have no visible clues as to their function. Every visible element that lets a human communicate with a computer must be put in by the user interface designer. The great challenge facing our computerised society nowadays is that in order to get the maximum benefit from computers we have to start seeing the user interface as integral to the computer system itself, rather than as an add-on when you have already decided how the computer is going to work. (quoted in Hicks & Essinger, 1991, p. 22)

Why have the visual attributes of the interface been underrated? First, developers harbour certain misconceptions and lack vital information about the discipline of graphic design. Many developers consider the graphic designer's purpose to be purely a cosmetic one, one devoted largely to enhancing the decorative details of the interface. However, graphic designers see themselves in broader terms — as visual translators and purveyors of communication and information (Vertelney, Arent, Liberian, 1990). "Commercial artists" are no longer considered visual cosmeticians who add frill and ornamentation to the advertising campaigns of yesterday. This new consciousness practices a type of functionalism that simplifies meaning without sacrificing style. The new aesthetics is based, not on whim, but on the necessity to attract and capture the attention of viewers, and to direct and influence the way in which they respond to information. Today, visual communication is the primary vehicle for making immense amounts of information accessible, understandable and palatable.

Form and content: like entities

Graphic-based interfaces are rapidly gaining acceptance. Visual communication is central to what interface design professes to accomplish — that is, improving the way people use computers to think and communicate, to observe and decide, to debate and design (Rheingold, 1990). Tufte (1989, n.p.) claims "... careful attention to visual craft is a distinguishing characteristic of nearly all excellent user interfaces now in the marketplace." According to Hicks and Essinger (1991) research in cognitive science suggests that users prefer visual displays of information over verbal. The human eye-brain system automatically searches for a visual order and hierarchy in what it perceives. Hicks and Essinger assert that visual communication and aesthetics should:

- Convey the structure and order of things.
- Connect abstract concepts to life.
- Direct the user's focus and attention.
- Aid the user's perceptive and cognitive skills.
- Stimulate interest and excitement.
- Support navigation.
- Confirm interactions.
- Classify, distinguish, and reveal the relative importance of things.
- Reduce the amount of written language.
- Symbolise and represent things so that they can be directly manipulated.
- Stimulate recognition and recall.
- Establish mood and style.

Visual communication must not be dissociated from functionality and useability. It must not be relegated to a decorative role. Visual communication surpasses in many instances the capacity of a text to communicate. (Allmendinger 1990). Allmendinger goes so far as to suggest that the information age, with its overabundance of data, has evolved into the current *visual* information age. For this reason, useability and functionality are significantly enhanced when user interface adheres to the principles governing good visual design. Hicks and Essinger (1991, p. 81) predict that "Graphics-based interfaces will become predominant in the 1990s precisely because working in graphics mode give user interface designers a richer environment to exploit visual language and present powerful representations of structures and tasks."

Admittedly, at first glance many perceive the interface as merely a matter of elements arranged on a background. The experts argue that this perception is ill-founded. Rand (1970, p. 9) states that visual communication is the "embodiment of form and function: the integration of the beautiful and the useful," while Hurlburt (1977, p. 94) adds that "A design can be considered successful only when it is a synthesis of all available information translated into words and images and projected in a dynamic form." Hicks and Essinger (1991, p. 78) state that "An aim of graphic design in relation to the user interface is to provide powerful structures and reinforcements that guide visual perception and communicate the hierarchy of information present in a system." Graphic design manages complex information through order, abstraction, simplification, grouping, coding, prioritising, and assigning relative value to different types of information.

The Design Process

Graphic design differs from many other disciplines in that alternate solutions perennially exist for a given problem. The graphic designer's role is to accept and examine the problem, set priorities, and then discover, implement and evaluate the solution that best meets the problem's criteria. This is referred to as the design process. The design process combines both convergent and divergent styles of thinking. Hurlburt (1981, p. 12) comments that "... insight, imagination, and intuition blend with rational analysis to create a synthesis and arrive at a design concept." Design is a problem-solving activity that embodies creative problem-solving methodologies. Koberg and Bagnall (1991) formulated the following seven-step creative problem-solving model. Although listed linearly here, the stages need not be implemented in a linear manner.

Stages of creative problem-solving

1. Acceptance

When the graphic designer accepts a project, he or she commits to directing sufficient energies toward creatively resolving the problem and completing the task. Motivation must be self-initiated and last throughout the duration of the project.

2. Fact finding

Lawson (1986) lists four basic sources of information available in design decision-making: the designer's own experience, the experience of others, existing research, and new research. Much of the material that a graphic designer must incorporate into a solution is predetermined. Frequently, there are strict copy specifications, a prescribed format, use of required medium, and a host of other requirements. Rand's famous statement that "Graphic design is play instincts within constraints," comes to mind. Once the problem's limitations are digested, the graphic designer is free to explore the language of design, the theories of visual perception, as well as the users' instincts, intuitions and emotions. The graphic designer usually requires additional information to solve a problem creatively. These materials are requested from the client, and gathered from a variety of sources both traditional and electronic. Other research strategies include: investigating similar problems, studying the competition, and conversing with users, colleagues, friends and family.

3. Definition

A problem is defined by breaking down and reorganising previously collected information into the components of who, what, why, when, where and how. These translate into the criteria required to solve the problem. It is imperative in designing for electronic media that problem criteria be well developed. A computer generates numerous options, regardless of quality and fit. The more established the criteria, the easier the process of weeding out, and consequently, the more credible the selection. It is not unusual for the problem to be defined and then redefined to better serve the criteria. In some instances there is more latitude in the design problem than the initial requirements suggest. In other cases, either altered criteria or a reexamination of the problem provokes a significant restructuring of the design enterprise.

4. Ideation

Ideation is the core of the creative problem-solving process. Information gathering, thorough research and problem definition, joins forces with, intuition, inspiration, and even accident to formulate innovative and appropriate solutions. Ideas are generated through brainstorming sessions and other creativity evoking techniques. Incubation is another important facet of ideation which Hurlburt (1981, p. 12) describes as "... a calm, detached period in which the factual material that has been analysed and absorbed into the conscious level of the mind can contact and be influenced by the intuitive forces of the preconscious or inductive level of the mind." The objective, no matter what specific processes are practiced, is to generate and record a significant quantity of idea options.

Computers provide the luxury of high quality display (and output). It is satisfying to generate ideas in precise scale with perfectly positioned elements specified in the correct type. However, this level of visual sophistication can sabotage the creative process by circumventing the loose, doodling and sketching stages of traditional ideation. The problem-solver must beware not to sacrifice the freedom of an idea to the highly evolved, representational qualities of new electronic media.

5. Idea selection

In the selection stage, ideas should be measured according to the problem's criteria. The ideas that best fit the criteria are either explored further or are selected and implemented. However, in visual communication there are so many variables that cannot be measured or compared that value judgments are unavoidable, and for this reason the role of the graphic designer is interpretive. Lawson (1986, p. 40) suggests:

> ... there is no natural end to the design process. There is no way of deciding beyond a doubt when a design problem has been solved. Designers simply stop designing either when they have run out of time or when, in their judgment, it is not worth pursuing the matter further. In design then, rather like art, one of the skills is in knowing when to stop.

6. Implementation
This stage involves the production of the chosen solution. In interface design prototypes are produced and tested until the application is proven effective.

7. Evaluation
Ideas are conceived, explored, reviewed, revised and even replaced many times over. As discussed previously, it is essential to solicit user feedback and to evaluate the project at various points during the design process, instead of doing so only at completion. Typically, graphic designers are buffered from the user because they work for and with clients. Often clients approach graphic designers because they do not fully understand the problem themselves. In addition, clients are rarely users. This makes the design task more difficult. As a result, designers rely on cognitive scientists to tell them what users supposedly need. Lawson (1986 p. 67) complains this liaison is not collaborative because "Social science remains largely descriptive while design is necessarily prescriptive ..." It is important that the designer, whether novice or expert, has as direct an access as possible to the user population throughout the duration of the project.

Integrating Graphic Design into User Interface Design

Any mark on the screen, how ever small or inconsequential, represents a graphic element rife with meaning and bursting with visual cues. Danger exists in the poorly designed or under or over-designed interface. Inferior graphic design can sabotage a good concept. Novice graphic designers often are guilty of over doing symmetry, working exclusively in one-dimension, cluttering the screen, relying heavily on clichés, and interpreting the concept too literally. As Tufte (1990, p. 51) points out "Clutter and confusion are failures of design, not attributes of information." Cognitive psychologists suggest that the more complex a tool is, the more inclined users are to believe that their inability to use it easily and efficiently is their own fault (Hicks & Essinger, 1991). If users are confused or misguided by a poorly designed interface they tend to internalise the failure because they have been indoctrinated to believe that computers never make mistakes. This response is especially harmful in the case of educational applications where frustration and failure compromise learning.

Application developers who incorporate the principles of quality graphic design into their interface design will fulfil all the requirements of functionality, useability and visual communication and aesthetics. Nanny (1990, p. 88) believes "Those [interface designers] who are able to express their ideas clearly and efficiently in a visual manner will be most successful at gaining an audience for their ideas." The user is already conditioned to expect sophisticated, visually-oriented media. Imagery from the broadcast media, the advertising industries, music, film and video games bombard modern users daily. The application developer has four choices for deciding how to better integrate visual communication and aesthetics into interface design: 1. Muddle along as is; 2. Hire a graphic designer; 3. Hope that an expert system will soon be developed to solve design problems; 4. Acquire the skills.

1. Muddle along as is

The accepted practice for developers is to pattern their interface after existing products that have already proven successful in the marketplace. In addition, most authoring tool packages provide libraries and clip art collections of ready-made graphic elements from which the developer can browse and borrow. In addition, there are numerous resource manuals for interface standards that dictate the look and behaviour of design elements. The problem with these approaches is twofold. First of all, imitation pales in the face of innovation. There is no substitute for having a working knowledge of the principles that guide good visual design. Tufte (1989, n.p.) warns "Design quality and consistency grow from a coherent set of ideas, not from personal taste or committee compromises, not from the baggage of past user interfaces, not from *ad hoc* reasoning about each little part of the computer screen." Secondly, although authoring packages supply the basic components for designing a visual interface, they cannot educate the developer in their effective use. Graphic libraries and clip art collections cannot substitute for creative design. Nelson (1990, p. 236) commiserates "… almost no one seems to be able to recognise *good* design — except users, and that only sometimes." Furthermore, because the design process is iterative, it is extremely time consuming for the novice. The developer runs the risk of spending too much time adjusting visual elements — time better spent in their own area of expertise.

Even when developers have the luxury of working with graphic designers, it is still in their best interest to educate themselves about the principles of visual communication. The developer/graphic designer relationship will prosper when both participants can at least understand each other's language. It should be noted that both professions approach problem-solving in similar ways, and the similarities create an air of familiarity between disciplines that facilitates learning.

2. Hire a graphic designer

Rand (1985, p. 233) argues that "Design is a way of life, a point of view. It involves the whole complex of visual communication: talent, creative ability, manual skill, and technical knowledge. Aesthetics and economics, technology and psychology are intrinsically related to the process." In short, graphic design is interdisciplinary in nature. The intent of both knowledge and natural talent required of an entry-level graphic designer is formidable. The following summary of the University of Tennessee's four year, undergraduate, graphic design degree program illustrates this point.

Required courses
Basic Design
Colour
Three-dimensional Design
History of Art
History of Graphic Design
Layout
Typography
Production
Photography
Drawing and Illustration
Creative Problem-solving Methods
Studio Art
Identity Systems
Computer-enhanced Design
Professional Practices
Practicum

Recommended courses
Computer Science
Human Factors
Speech
Communications
Advertising
Marketing
Broadcasting
Business Management
Foreign Language
Journalism
Philosophy
Psychology
Liberal Arts

General curriculum
English Composition
History
Natural Science
Social Science
Mathematics
Foreign Language

Although the trend in interface design is to do without a professional graphic designer, it is quite obvious that the expertise that a graphic designer brings to a problem greatly enhances the product. Effective graphic design does more than gain the attention of the user, it provokes an intellectual or emotional response. In Rand's (1985, p. xiii) words "Graphic Design is essentially about visual relationships — providing meaning to a mass of unrelated needs, ideas, words, and pictures. It is the designer's job to select and fit this material together — and make it interesting." Even if developers immerse themselves in the literature, they cannot equal the expertise of a graphic designer, gleaned through practice, talent, apprenticeship, and proximity to good design. The new class of software is visual, culturally connected, and often metaphorical and rich beyond conventional code. And it desperately needs the attention of a graphic designer (Rettig, 1992).

There are not many graphic designers who have an expertise in graphic design for the interface because the field is so new, and the level of technological competence so high. However, this should not deter a developer who seeks assistance. Those graphic designers who exhibit an aptitude for information design, who have experience with desktop publishing systems and other new technologies, who are comfortable working within a team, and are who genuinely interested in the project will be effective designers for the interface. If funds are restricted, graphic design students could be utilised in a practicum situation. Students are often experienced in computer-enhanced design through coursework and have had time to experiment with both software applications and hardware.

Involving the graphic designer at the beginning of the design process is essential. If functionality, useability, and visual communication and aesthetics are equally important, then the intent, concept, code and program interface with all of its visual elements should evolve simultaneously. The best way to work with a graphic designer is to include him or her as a member of the original development team. A team approach to interface design is preferred because of the multifaceted nature of a project's development. The advantage of group participation is that team members, with varied backgrounds and points of view, can bounce ideas off each other. The team provides a forum for members to expand their knowledge base beyond the boundaries of their own disciplines, thereby enriching the problem-solving process.

Finally, it is important that both the developer and graphic designer be open to each other's suggestions and respect each other's opinions. It is only natural for developers to think they know more about their problems than does the graphic designer, despite the fact that developers hire designers to solve such problems. (Potter, 1980). It is important to keep in mind how much specialised knowledge a graphic designer brings to the project. Berryman (1979, p. 42) reminds us that:

> Everyone "looks" at things but very few people see effectively. Designers must be able to "see." Seeing means a trained super-awareness of visual codes. ... These codes help make up a language of vision. ... [Designers must first become] visually literate, to understand how to 'read' visual communication language; then [visually] intelligent, to be able to 'write' or create in this special channel.

3. Hope that an expert system will soon be developed to solve design problems

In the early 1980s Harold Cohen, a British artist, programmed a computer to create drawings based on the fundamental principles of design. The computer was "taught" to emulate his rather abstract style of drawing. In this program he also incorporated some of the rudimentary elements of artificial intelligence, including the ability to learn from past mistakes. (Kluger, 1987). The purpose of Cohen's experiment was to create "aesthetically correct" works of art but, unlike the visual elements in Cohen's artwork, the elements in visual communication must convey meaning. Visual communication and aesthetics are extremely complex affairs. Shneiderman (1987, p. 326) who admits that "Screen design will always have elements of art that require invention, but some principles are becoming clearer," claims that it is very unlikely that an expert system for graphic design can be effectively implemented because "... the demands of each task and user community are so varied and difficult to measure."

4. Acquire the skills

If developers do not want to "muddle through as is," but for reasons of time, budget or location, cannot hire or arrange for the services of a graphic designer, they can make a commitment to acquire the skills. By keen observation and an intense curiosity, an individual can cultivate a sensitivity to visual communication. Rand (1985, p. 79) comments "... curiosity is the common denominator and the pleasure of discovery an important by-product." As mentioned previously, resources are available to instruct software developers on how to design for the visual interface. Some of the more popular of these resources include: Apple Computer, Inc. (1989), *HyperCard Stack Design Guidelines*; Marcus, A. (1992), *Graphic Design for Electronic Documents and User Interfaces*; Shneiderman, B. (1987), *Designing User Interfaces: Strategies for Effective Human-Computer Interaction;* Smith, S. & Mosier, J. (1984), *Design Guidelines for User Interface Software;* and Tufte, E. (1990), *Envisioning Information.*

Most of these sources provide guidelines and rules for working with type, imagery, icons, grids, colour, menus, windows, buttons, text fields, sound and animation. Others elaborate on visual style, screen structure, metaphor development, navigation techniques, concept sequencing and the control of time and space. The trouble with relying solely on rule-based instruction is that the developer runs the risk of following orders without understanding the principles supporting them. It is more important to kindle imagination, than to encourage imitation. Lawson (1986, p. 3) reminds us that "In the end perhaps design must be learnt rather that taught." Edward de Bono adds that (quoted in Lawson, 1986, p. 7) "On the whole, it must be more important to be skilful in thinking than to be stuffed with facts."

In academia as well as in the profession, graphic design has outgrown its vocational designation. It is now considered a discipline, with an intellectual foundation in theory, concepts and rules. The theoretical aspects of visual communication have evolved from semiology, Gestalt theory, and research into human perception and behaviour. Although theory plays an important role in academic research by providing the concepts and a language to analyse and study design strategies, it is the practitioners who actually do the designing. In most cases, theory is too abstract to be immediately useful to the interface designer. On the other hand, design concepts, derived from theory and drawn from the rich resources of traditional fine art and design are directly applicable to interface design. These concepts serve as the intermediaries between abstract theory and concrete, rule-based learning. Concepts explain why particular design decisions are made, and not how to make them. For example, a rule dictating the use of colour in the interface reads "Never use more than five, plus or minus two, colours" (Marcus, 1992, p. 82).On the other hand, a concept describes the interactions between colours and explains why choice should be limited. Hicks and Essinger (1991, p. 75) suggest "It is useful to think of graphic design not as a mysterious, artistic process to which few have access, but as a method for implementing visual language that has some basic principles which can be powerfully applied to solve communication problems."

By definition then graphic design should be predicated on concepts and not on rules. A developer who understands the principles behind effective graphic design will have control over his or her visually-oriented decisions. Leading educators promote this style of active, participatory learning over the more traditional, passive model. After all, active learning is the impetus behind educational technology. Rule-based resources have their place as reference tools, but they are no substitute for actively learning and applying the concepts that embody the vocabulary of vision.

The Vocabulary of Vision

The vocabulary of vision is the foundation of traditional design. It is composed of the three fundamental elements of design (point, line, and form); their attributes (volume, size, colour, texture); and their behaviour and interrelationships (structure, balance, contrast, direction, movement, position and space). These coexist within the boundaries of a visual field. In interface design the monitor's display defines the visual field. The principles of the vocabulary of vision seldom work in isolation, but rather in complex and integrated combinations. In visual communication, design elements, their attributes and relationships with each other, with and within the visual field, represent a complex order of visual signs imbued with content and meaning. The fundamental design elements of point, line and shape translate into the following visual signs common to interface design: titles, subtitles, copy, icons, windows, menus, dialog boxes, cursors, design devices, rules, bars, borders, diagraphics, illustrations, photographs, video imagery, animation, etc. Elements are chosen according to the nature of the task, the abilities and preferences of the user, and the abilities of the system (Allmendinger, 1990). Kepes (1944) considered design elements to be living organisms, with laws of growth and structure, that exhibited both internal and external forces.

Developers versed in the vocabulary of vision can create and guide design elements to yield a clear, distinct and consistent visible language that ultimately will improve the quality of visual communication, functionality and useability of the user interface. The principles comprising the vocabulary of vision described below are derived from several sources including: Albers (1975), Berryman (1979), Dondis (1973), Kepes (1944), Hurlburt (1977, 1978 and 1981), Rand (1970 and 1985), and Wong (1972). The illustrative figures used here taken directly from a HyperCard stack developed specifically for live presentation of this material.

Design elements

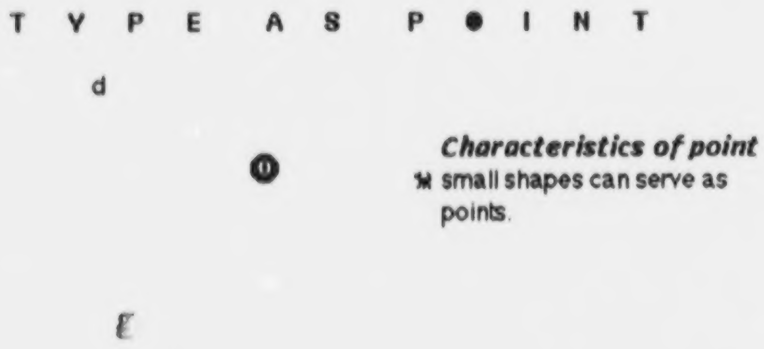
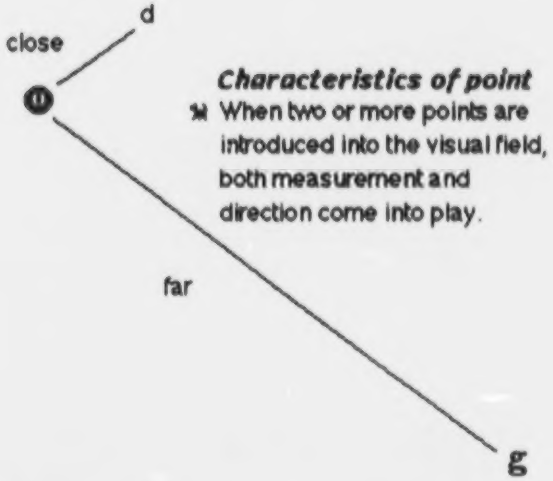


Figure 1

1. Point

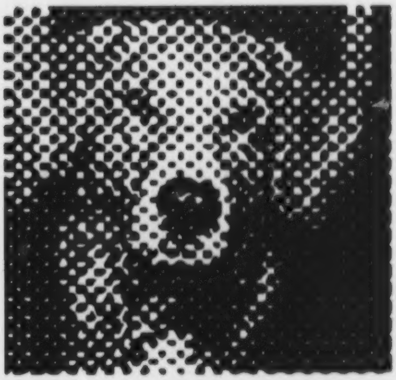
A point is the smallest unit of visual communication. It is relatively simple and compact in shape. It has the inherent ability to draw attention to itself because of its concentrated energy. Bullets, dingbats, small forms, and even letters can serve as points if they are small enough in relationship to the other design elements and visual field (Figure 1). When two or more points are introduced into the visual field, both measurement and direction come into play (Figure 2). There is a tendency to connect points. Therefore, a series or collection of points will lead the eye in a specific direction or sometimes suggest an outline of a representational form. Many points scattered across a visual field activate the surface. The degree of activation is directly proportional to the number and proximity of the points. In great profusion these dots can create the illusion of tone or colour as in percentage screens, halftone or grey scale imagery, and full colour reproduction for print (Figure 3).



Characteristics of point

- When two or more points are introduced into the visual field, both measurement and direction come into play.

Figure 2



Characteristics of point

In great profusion these "dots" can create an illusion of tone.

Figure 3

2. Line

A line is defined by its narrow breadth relative to its prominent length. The visual path of a line has direction and purpose. Lines come in a variety of shapes, lengths, widths, patterns and textures. Design elements interpreted as line are rules, bars, leader dots, borders, and sentences of type. A line joins, organises, emphasises, supports, separates and even protects other design elements. Lines have the capacity to express empathy. Horizontal lines represent stability, vertical lines represent balance and order, and diagonal lines are dynamic. Examples of a line's emotional quality include the following: thick implies boldness, thin denotes delicacy, and length introduces the concepts of time and duration (Figure 4). An organic, meandering line appears slow, whereas a zig-zag configuration conjures up quick-paced excitement. Numerous lines in a visual field can generate rhythm or overall chaos (Figures 5 & 6). Imagery can also be rendered using line (Figure 7). Line art illustration can be easily incorporated into a software application because it scans well, does not consume too much disk space, and is readily available in published collections of public domain drawings, etchings, and engravings.

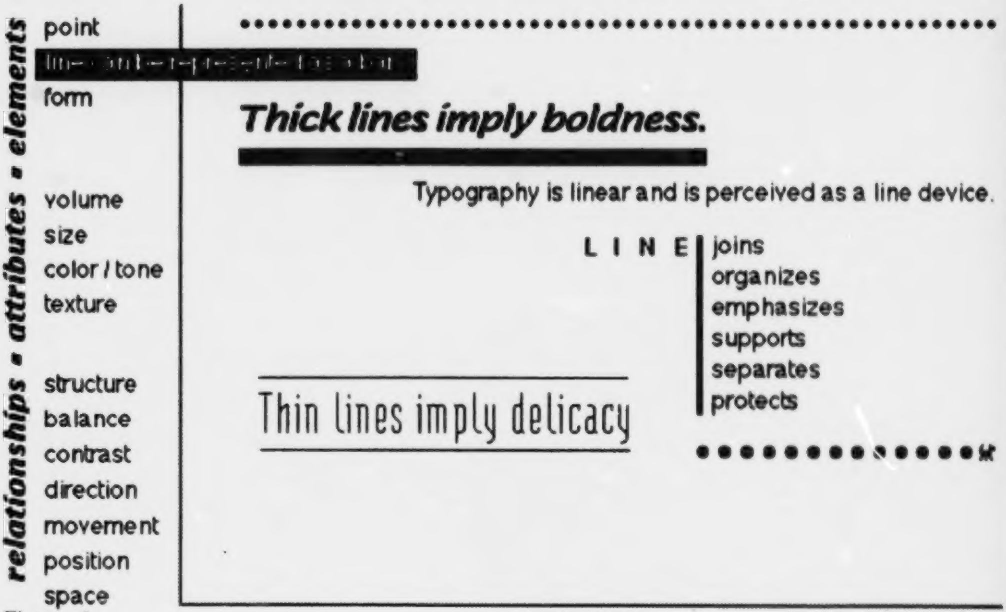
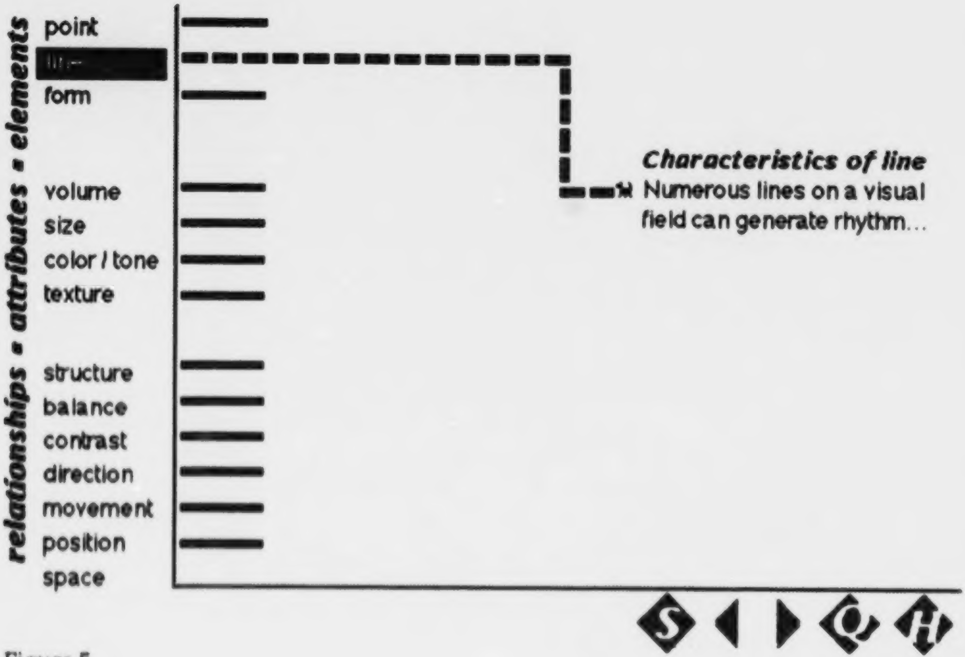
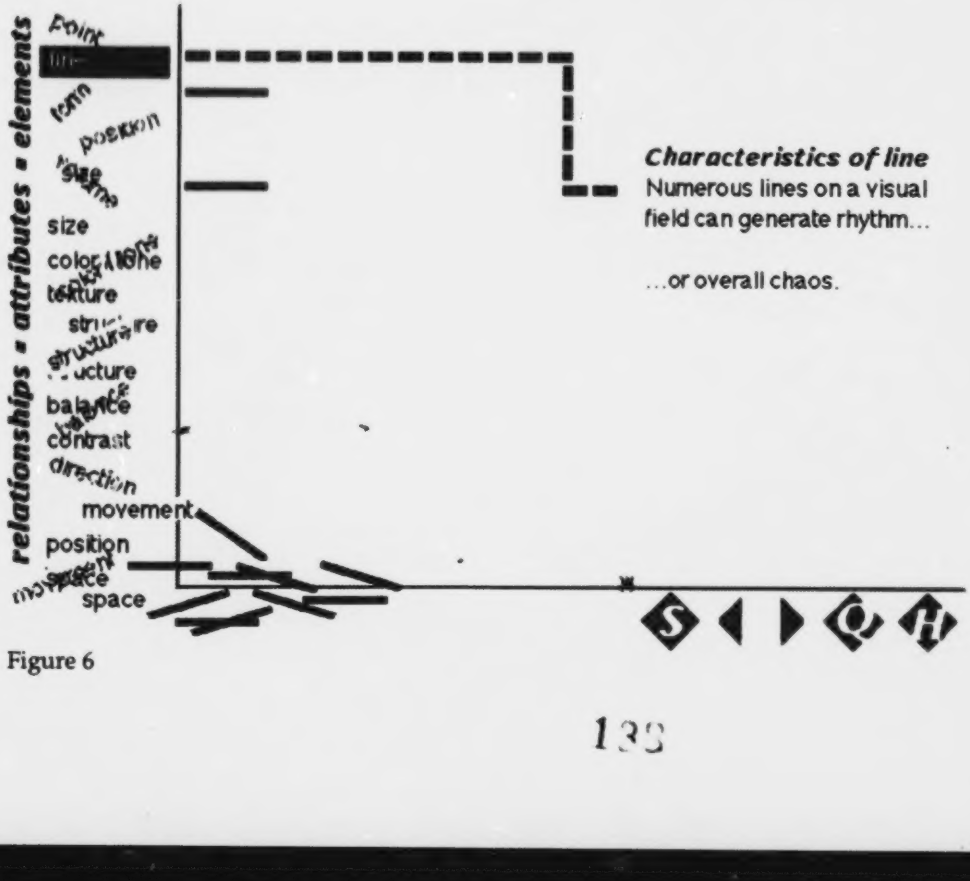

relationships • attributes • elements
point
form
volume
size
color / tone
texture
structure
balance
contrast
direction
movement
position
space
Thick lines imply boldness.
Typography is linear and is perceived as a line device.
LINE
joins
organizes
emphasizes
supports
separates
protects
Thin lines imply delicacy

Figure 4


relationships ▪ attributes ▪ elements
point
line
form
volume
size
color / tone
texture
structure
balance
contrast
direction
movement
position
space

Characteristics of line
Numerous lines on a visual field can generate rhythm...

Figure 5


relationships ▪ attributes ▪ elements
point
line
form
position
size
volume
size
color / tone
texture
structure
structure
structure
balance
contrast
direction
movement
position
space
space

Characteristics of line
Numerous lines on a visual field can generate rhythm...

...or overall chaos.

Figure 6

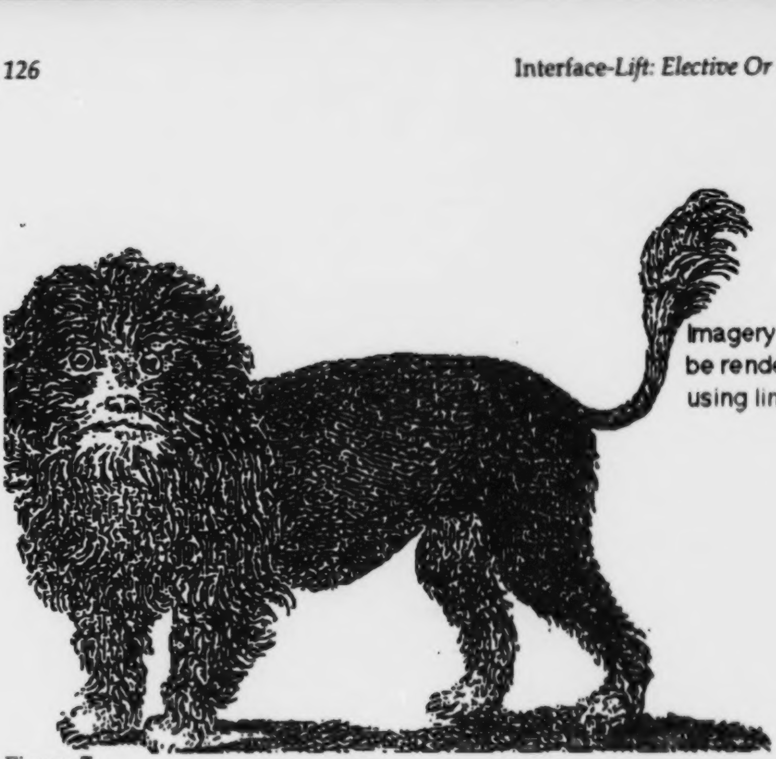


Figure 7

3. Form

Forms are created when line meets itself to enclose space. Shapes are perceived even if the form is incomplete. The Gestalt theory of "closure" cites that humans have a natural tendency to mentally complete partial forms because closed shapes are regarded as stable (Figure 8). There are many different types of forms — geometric to organic, mechanical to accidental.

The enclosed area of a form takes on a positive or negative value (Figures 9 & 10). This is referred to as a figure/ground relationship. Figure is the visual image, and ground is the background field with in which the visual image resides. If the percentage of figure to ground is relatively equal, the mind fluctuates between the two, resulting in a kinetic and "noisy" image, as seen in moiré patterns and other similar optical illusions. Joseph Albers (cited in Tufte, 1990, pp. 53-65) described a visual effect he called "1 + 1 = 3 or more." When two elements exist in proximity, assorted incidental by-products of their partnership are created. The negative space trapped between design elements, in themselves, can command shape and change the meaning or add clutter to the layout. An invisible form can be subtracted out of a visible form, changing the overall shape of the visible form (Figure 11). All areas within the visual field, whether they are occupied or not, are important.

Characteristics of form
The theory of "Closure" cites a natural tendency to complete partial forms.

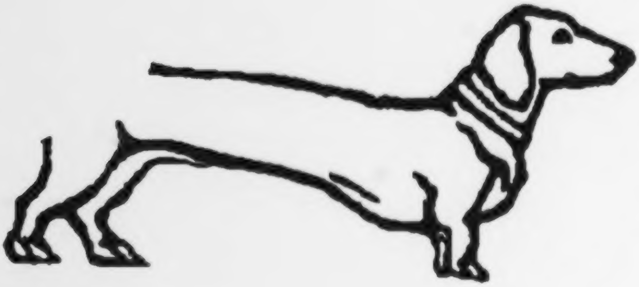


Figure 8

Characteristics of form
The enclosed area of a form takes on a positive or negative value.

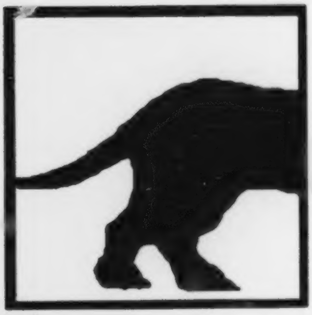


Figure 9

Characteristics of form

The enclosed area of a form takes on a positive or negative value.

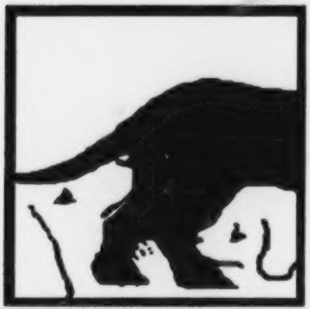


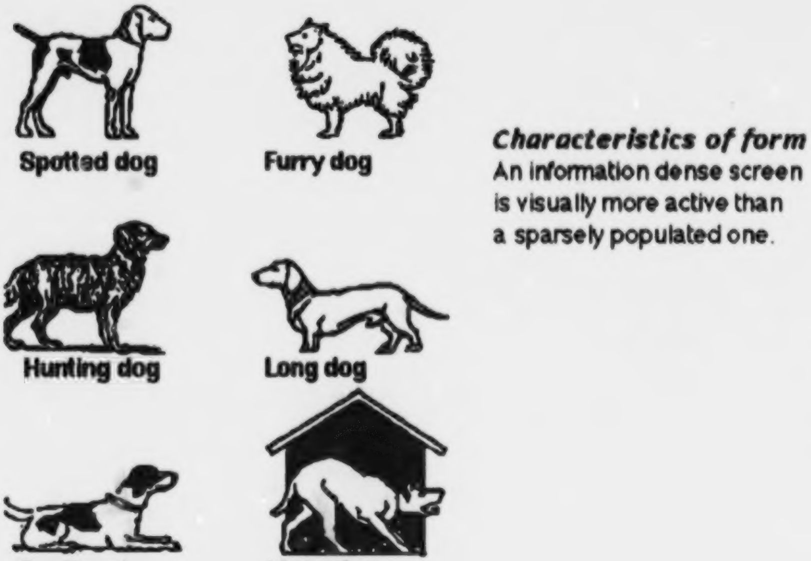
Figure 10

Characteristics of form

An invisible form can be subtracted out of a visible form, changing the overall shape of the visible form.

Figure 11

The number of forms and the way that they reside within the visual field affect the overall ambience of the interface. An information dense screen is visually more active than a sparsely populated one (Figures 12 & 13). Organisation can be formal or informal with forms positioned in an orderly fashion or scattered haphazardly. One of the most effective ways to provide rhythm, harmony, and consistency in design is repetition — repeating identical forms or similarly shaped forms. Gradation is a variation of repetition in which a form gradually changes in an orderly and progressive way (Figure 14).


Spotted dog
Furry dog
Hunting dog
Long dog
Resting dog
Mean dog

Characteristics of form

An information dense screen is visually more active than a sparsely populated one.

Figure 12

Characteristics of form

An information dense screen
is visually more active than
a sparsely populated one.

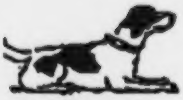


Figure 13

Characteristics of form

Gradation provides a
sense of progression.

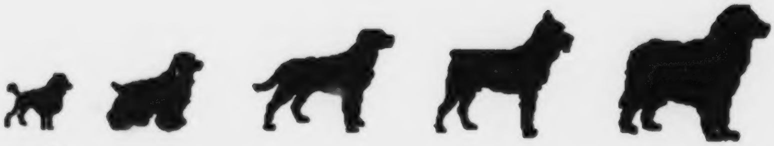
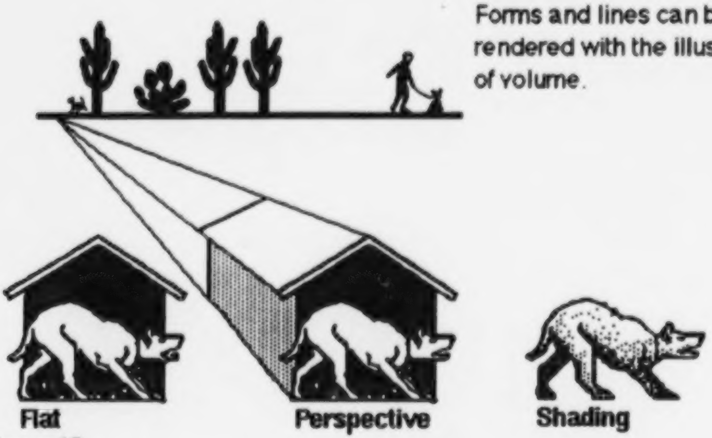


Figure 14

Attributes of design elements

1. Volume

Flat forms are reminiscent of thin sheets of paper hung in space. They parallel the picture plane. Even though the monitor's screen is flat, elements can be rendered with volume and depth by using size variations, shading, texture and colour shifts. Forms can also be drawn three-dimensionally using the illusion of perspective (Figure 15). The more voluminous an element, the more weight and energy it possesses.



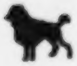
Characteristics of volume

Forms and lines can be rendered with the illusion of volume.

Figure 15

2. Size

Size refers to the dimensions of an element and the amount of space it occupies. The size of an element is relative to the size of the other elements on the visual field and the size and proportion of the visual field itself. The more expansive the visual field, the smaller the element will appear and vice versa (Figures 16 & 17). Size is a powerful manipulator of depth. Larger elements appear closer to the eye than do smaller ones. Clarity, brightness and detail reinforce the closeness of an element. Size also implies movement. When a series of elements is arranged according to size, the eye naturally follows the path of the progression (Figure 14).



Characteristics of size

The size of an element is relative to the size of the other elements on the visual field and the size and proportion of the visual field itself.

Figure 16

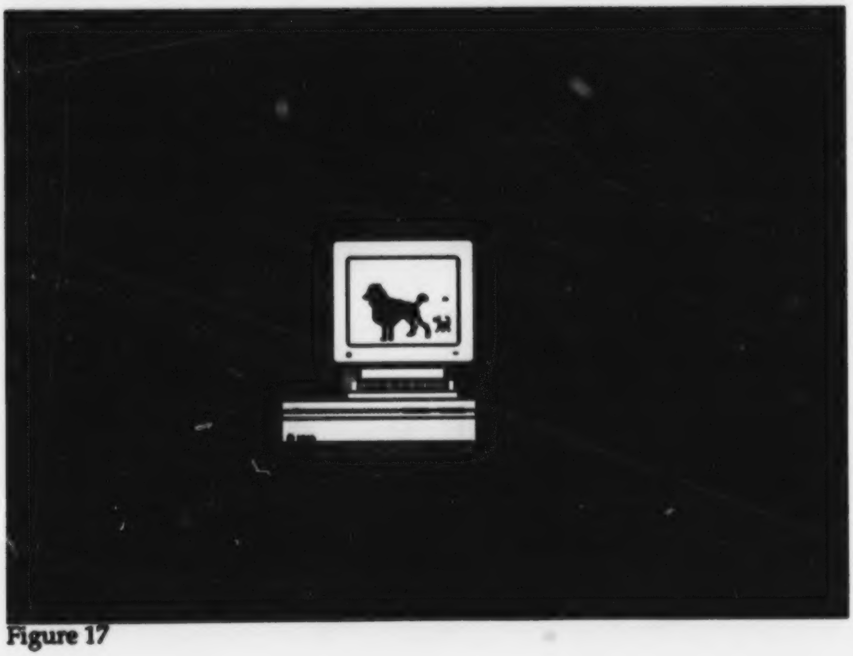


Figure 17

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3. Colour and Tone

Colour is determined by hue, saturation and brightness (whether it be pigment or light). Hue is the colour or chroma itself; saturation is the relative purity of the hue; and brightness is the measurement of the light-to-dark value of the hue. Tone is defined as brightness, or the light-to-dark value, in a monochrome environment. It is usually represented by percentage screens or textured patterns (Figure 18). When tonal variations are substituted for colour, some of the emotional qualities of colour are lost, but many of the other colour attributes are still applicable. Colour possesses the following attributes (Marcus, 1992 & Tufte, 1990):

- Commands attention.
- Identifies and labels elements.
- Formats, organises and codes data.
- Portrays objects more realistically.
- Conveys hierarchy.
- Increases appeal, believability, comprehension, and recognition.
- Portrays time and progress.
- Indicates change in status.
- Increases information density.

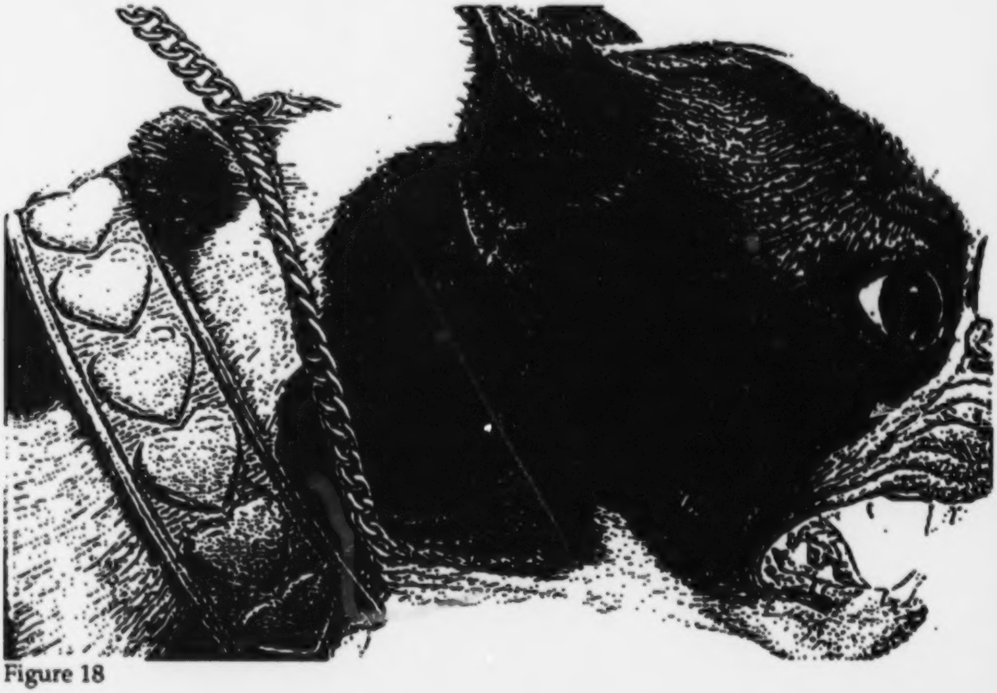
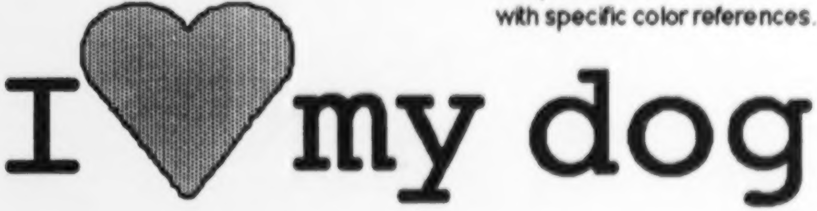


Figure 18

These attributes contribute to enhanced learning and recall. The use of colour has also been proven to reduce errors (Marcus, 1992). Colour and tone should be used sparingly and consistently to directly support the task. To accomplish this, familiar colour schemes can be reinforced and shapes can be associated with specific colour references (Figure 19). Colour interacts with its own environment and must be selected it in context, not in isolation. Studies in perception prove that warm colours advance and cool colours recede, whereas dark colours appear closer on light backgrounds and vice versa. Adjacent, saturated colours jitter and bleed while adjacent, low-contrast colours blend and fade. To remedy this, Tufte (1990) suggests observing and emulating the palettes used in nature.



Characteristics of color & tone

Familiar color schemes can be reinforced.

Shapes can be associated with specific color references.

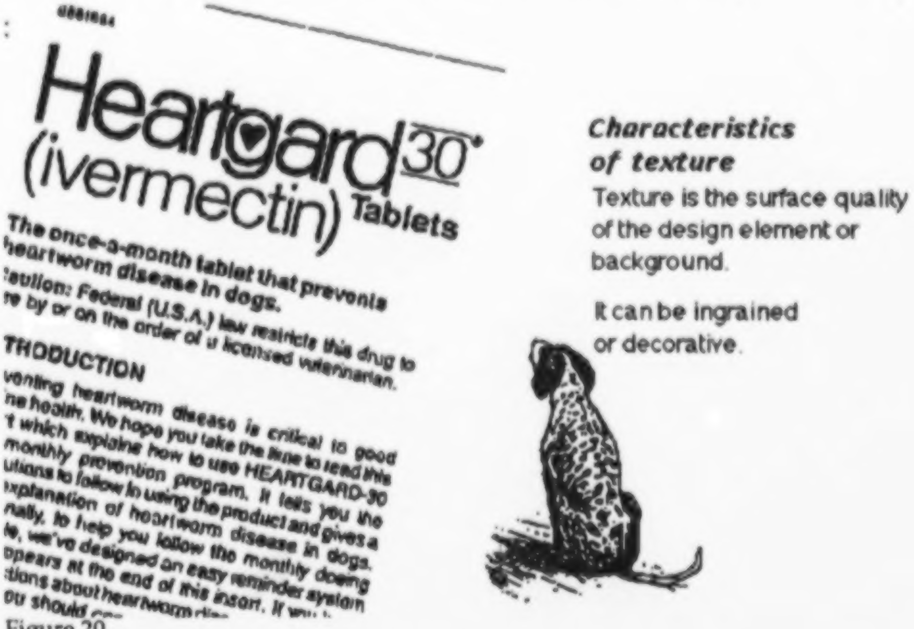
Figure 19

Colour is easily abused by overuse and poorly matched palettes. Tufte (1989, n.p.) lists the first principle of colour use as "Above all, do no harm." Colour incorrectly used in interface design can contribute to eye fatigue and impair the learning process. In an international market, colour can be culturally confusing, even offensive. Colour should not be the only attribute used to differentiate values of information because there are too many perceptual shifts and ambiguities possible (Tufte, 1990). In some cases, the small portion of the population that suffers from colour deficient vision should be taken into consideration. Furthermore, colour is often chosen subjectively, based on personal preference, fashion, or whim. A colour combination that is stylish today might soon appear conspicuously outdated.

There are also technical problems to consider when using colour. Hardware compatibility becomes an issue because not all machines are capable of generating colour output. Colour requires additional memory. Furthermore, affordable colour monitors display pictures at a lower resolution than their monochrome counterparts. Colour quality is often inconsistent across the user base because even identical brand monitors are calibrated differently. External conditions such as room lighting also affects colour perception. Finally, colour is usually more time consuming to develop and expensive to produce.

4. Texture

Texture is the surface quality of the design element or background. A textural quality is either indigenous to the design element, as, for example, the tonal qualities of a paragraph of copy, or it can be added as a decorative surface, as, for example, the pattern of fur (Figure 20). Elements with crisp textural detail appear closer than elements with diffused textures. Lighting can also affect texture, especially when the light source produces shadows. On the computer screen texture has no tactile quality, only an optical presence. Many of the paint palettes residing in authoring packages provide a wide variety of editable textures for drawing, lettering and filling shapes. Like colour, texture can be overused and misused. Texture should never dominate. It should be used sparingly to add visual stimuli and reinforce meaning.


Heartgard30®
(ivermectin) Tablets
The once-a-month tablet that prevents
heartworm disease in dogs.
THODUCTION

Characteristics of texture

Texture is the surface quality of the design element or background.

It can be ingrained or decorative.

Figure 20

Behaviour and interrelationships of design elements

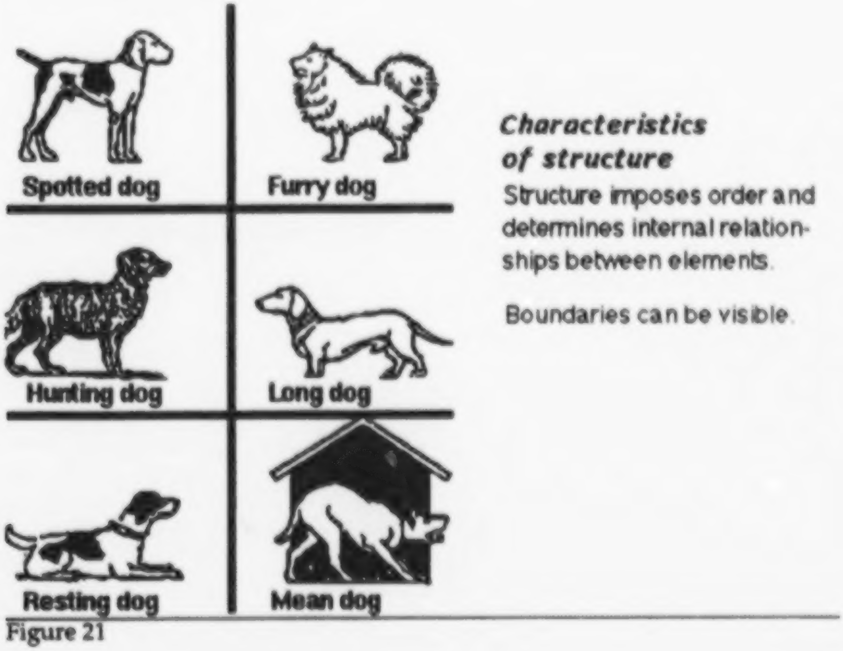
1. Structure

Structure refers to an infrastructure that governs the position and proportional qualities of design elements residing in the visual field. Generally, it imposes order and determines internal relationships between elements. Structure can be informal, in which case organisation is free and indefinite, or it can be formal, with the structural lines and divisions rigidly and mathematically drawn. Informal structure relies on the designer's own natural and intuitive sense of proportion, whereas formal structure relies on a grid system. Grid systems bring cohesiveness to a visual piece by making complex information understandable through organisation. Gestalt data reveals that humans tend to prefer organised visual and verbal information (Berryman, 1979).

Hicks and Essinger (1991) report that studies of human memory and cognition prove that the human visual system is designed to produce organised perception. Rand's (1985, p. 195) observations about the grid in traditional graphic design can be readily applied to electronic media.

> The grid system employed by the designer provides for an orderly and harmonious distribution of miscellaneous graphic material. Creating the grid calls for the ability to classify and organise a variety of material with sufficient foresight to allow for the flexibility for handling content that might, in one way or another, be altered. The grid must define the area of operation and provide for different techniques, pictures, columns of text, page numbers, picture captions, headings, and other miscellaneous materials.

Structure can simply divide space with invisible or visible boundaries (Figures 12 & 21); or it can interact with design elements by providing varied backgrounds; or it can hide parts of elements that intersect with its structural boundaries (Figures 22 & 23). Visible boundaries are commonly represented as rules, bars, leaders, boxes, borders or colour bands. Grids can be varied even within the same application. Columns do not have to be equal in size. Division emphasis can be straight or curved; vertical, horizontal or even diagonal.



Characteristics of structure

Structure imposes order and determines internal relationships between elements.

Boundaries can be visible.

Figure 21

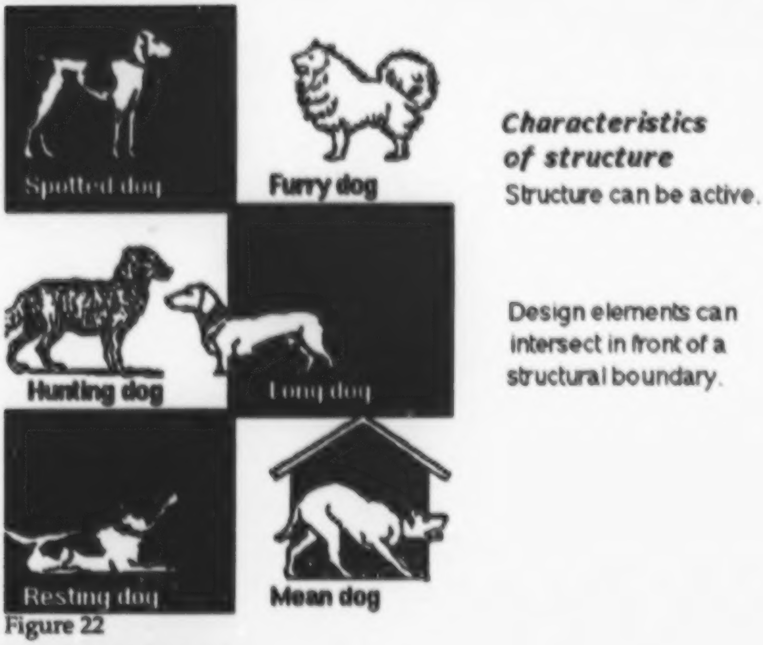

Spotted dog
Furry dog
Characteristics
of structure
Structure can be active.
Design elements can
intersect in front of a
structural boundary.
Hunting dog
Long dog
Resting dog
Mean dog

Figure 22

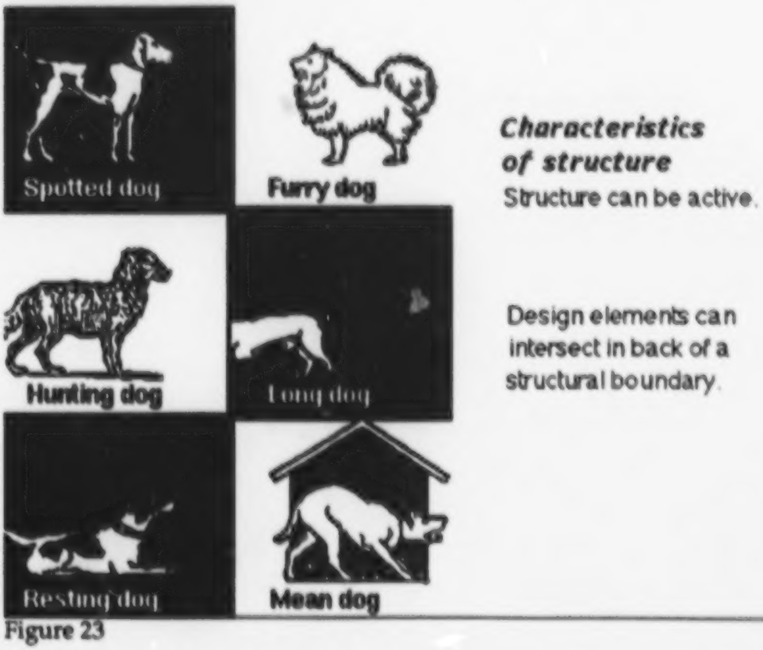

Spotted dog
Furry dog
Characteristics
of structure
Structure can be active.
Design elements can
intersect in back of a
structural boundary.
Hunting dog
Long dog
Resting dog
Mean dog

Figure 23

The graphic designer must design for the screen that contains the most amount of information, and at the same time, base the overall proportions of the grid on the

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smallest element used. Other factors influencing grid design are the viewer's distance from the screen, and the amount and complexity of the information that needs to be conveyed (Marcus, 1992). Content and meaning of the information must be factored into the placement. Related information should be grouped into units and placed in a hierarchical order.

A grid should serve the idea, not dominate it. An excessively complex, obtrusive grid will only confuse the viewer. On the other hand, a grid that is too simplistic for the information it contains might bore the viewer. As Hurlburt (1981, p. 111) warns "The important thing to remember is that while a grid can help to generate a sense of unity and continuity in a design, it is not in itself creative. In the hands of unskilled designers, grids can become straight jackets that inhibit creative concepts."

2. Balance

Elements arranged symmetrically line up along a central axis (Figure 24). The monotony of symmetry often interferes with the user's attention. Asymmetrical layouts incorporate tension and implied movement, dictated by element size, shape and position within the visual field to achieve balance (Figure 25). Although asymmetrical balance is more difficult to attain, it provides a more visually stimulating experience. For example, two small elements can balance a larger item. A block of copy in bold type will appear "darker" and heavier in the balance equation than a block of copy set in a lighter weight. Likewise, a copy block with tight leading, the space between lines, will appear heavier that one with more leading (Figure 25). The key is to create just enough tension to whet visual interest, without destroying visual harmony.

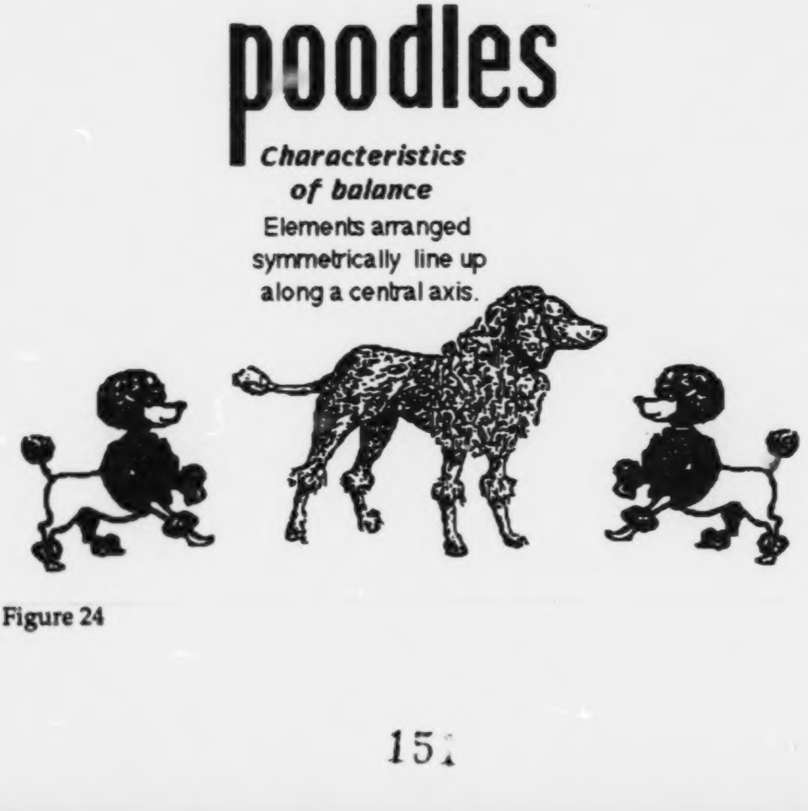

poodles
Characteristics of balance
Elements arranged symmetrically line up along a central axis.

Figure 24

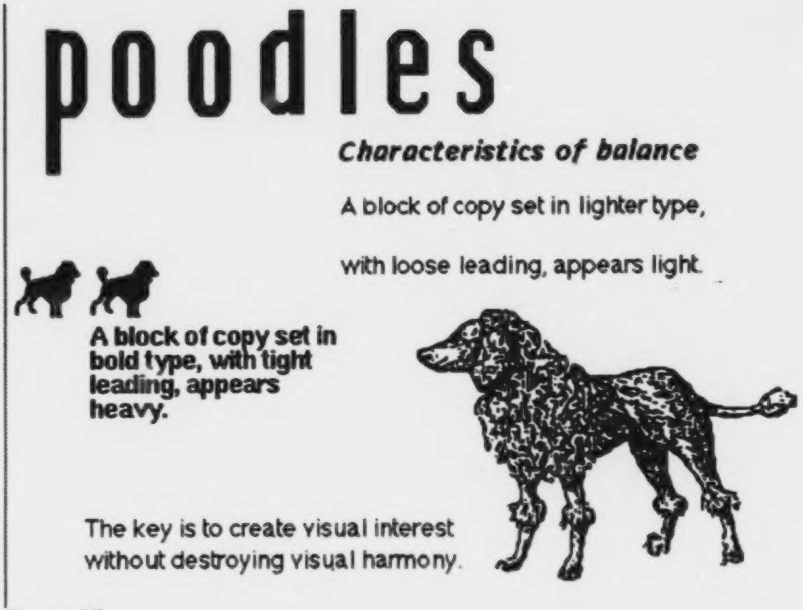
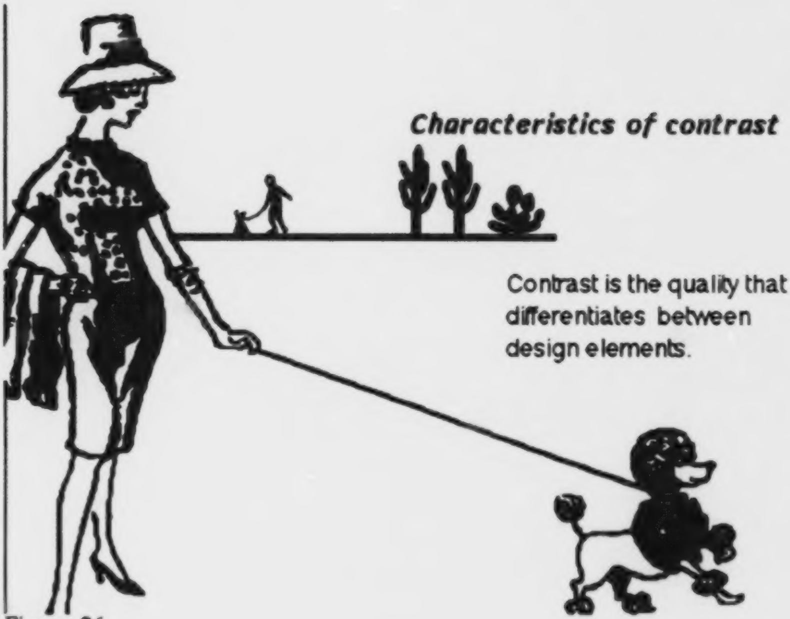

poodles
Characteristics of balance
A block of copy set in lighter type,
with loose leading, appears light.
A block of copy set in bold type, with tight leading, appears heavy.
The key is to create visual interest without destroying visual harmony.

Figure 25

3. Contrast

Contrast is the quality that differentiates between design elements (Figure 26). It reinforces visual hierarchy though emphasis. It affects the relationships between each and every principle of design, including mood and sound. When applying contrast to colour, tone, or texture, the element that appears bolder or brighter will advance and draw attention. This is useful in creating hierarchies for typographical information. The results of contrast of size are apparent. Elements that take up more space are considered more commanding. Contrast of mood relates to the implied message. A screen or application can contain more than one emotional stimulus. Content can be delivered aggressively or passively, humorously or sadly, loudly or softly, and so on. It is better to exaggerate the contrast between elements than to run the risk of confusing or boring the viewer by underplaying the differences. Dondis (1973) says that ambiguity, the most undesirable visual effect possible, is the enemy of design. Psychologically upsetting and visually misleading, it should be avoided.

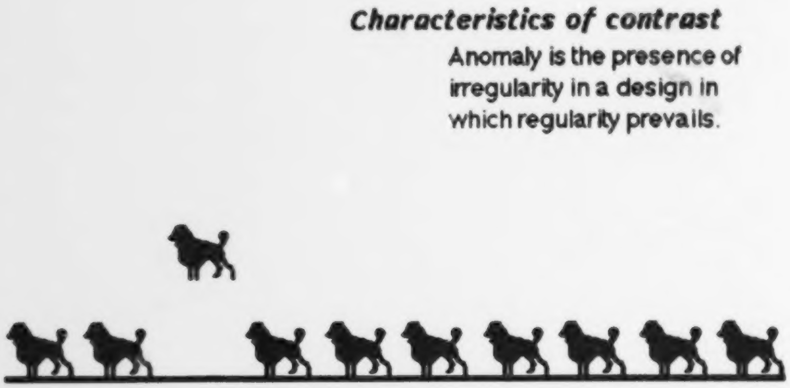


Characteristics of contrast

Contrast is the quality that differentiates between design elements.

Figure 26

Another type of contrast is anomaly. Anomaly is defined as the presence of irregularity in a design in which regularity still prevails (Wong, 1972). The design element that deviates from the norm becomes a focal point that adds interest, demands attention, relieves monotony, or provides transition. Anomalies are generated by altering or exaggerating any of the principles that make up the vocabulary of vision (Figure 27).



Characteristics of contrast

Anomaly is the presence of irregularity in a design in which regularity prevails.

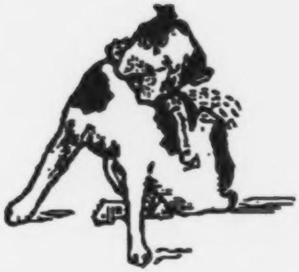
Figure 27

4. Direction

Direction refers to the path that the eye takes when scanning a visual field or tracking a design element. Direction is usually culturally derivative. Western cultures read left to right, top to bottom. Design elements arranged according to this principle appear to progress (Figure 14). In interface design, directional forces are not limited to right/left and up/down. They can also lead the eye in and out of space. Perspective rendering is a powerful force that provides this illusion of directional depth (Figure 15). Direction also plays an important role in navigation. If the developer is adhering to a specific metaphor, the conventions of direction that the metaphor defines should be closely observed. For example, pages of typical English language books flip to the left, at a fairly constant speed. On the other hand, actors enter a stage from different angles, at varying speeds.

5. Movement

Movement is implied in a static environment and actualised in an environment capable of generating full-motion (Figure 28). It has been proven that dynamic elements, including moving images, music and sound effects, attract more attention than text and still images (Ambron, 1990). In interface design, motion is suggested through card flipping, two-dimensional and three-dimensional animation or full-motion video. Motion is a powerful asset for navigating through data, creating transitions, simulating complex examples, providing alternative viewpoints, compressing or speeding up time, and energising inanimate objects. The Gestalt theory of continuation suggests that organisation in perception leads the eye to continue along and beyond a straight line or curve (Berryman, 1979). As a result, a viewer seeks motion, real or perceived, even on a static screen.



Characteristics of movement

Movement is implied in a static environment.

Figure 28

Nanny's (1990) research on motion for the interface focuses on the developer's control over space and time. Where you are, what you see, and what angle you see it from is affected by moving location (Figures 29 & 30). Tampering with size allows the user to scale him or herself, or the object, to observe things that are too big or too small to view from a normal perspective. The developer controls time by freezing it and adjusting the rate at which it passes. The user can select specific periods of time from which to view historical events and replay them for closer analysis. Events can be viewed that rarely occur or are difficult to observe in real life. The rate at which time passes can be compressed or expanded into manageable slices so that the user can observe things that normally are impossible to see in a normal time frame. In this environment, time can even be reversed.

Characteristics of movement

Motion permits different viewpoints of the design element.

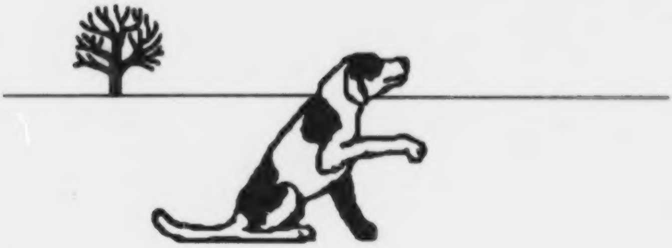


Figure 29

Characteristics of movement

Motion permits different viewpoints of the design element.

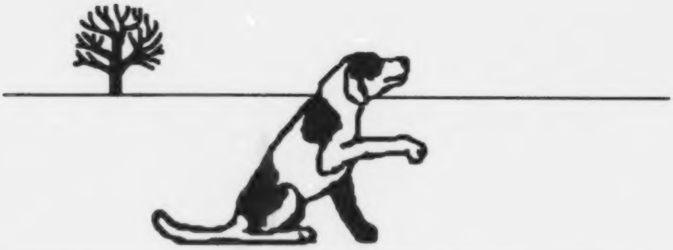


Figure 30

6. Position

The ability of the eye to assemble and arrange elements and to understand their meaning is at the root of the design process. Elements can be positioned to create tension that, in turn, stimulates viewer response and enhances continuity. Gestalt theory suggests a natural tendency to organise visual components into a unified whole. Elements in proximity, especially if identical or similar in shape, size, colour and direction, often form sub-groups or units. They are composed of a combination of separate points, lines and forms, that visually merge into a complex but unified new form (Figures 31 & 32).

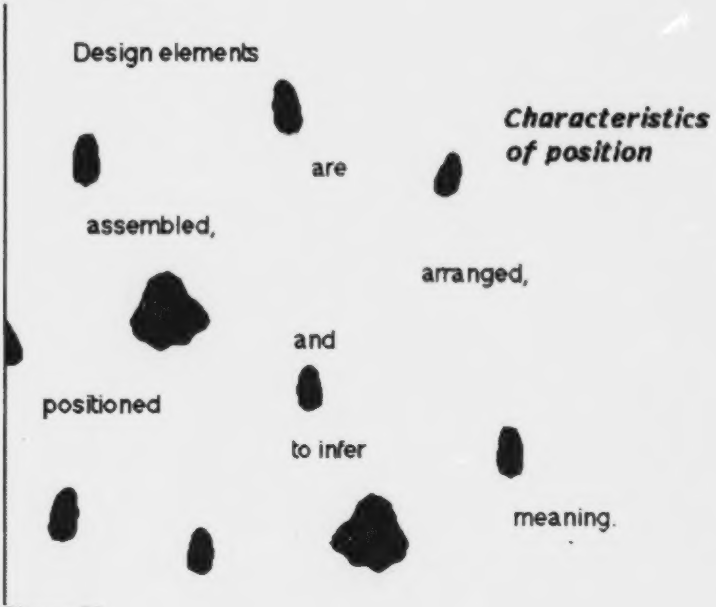
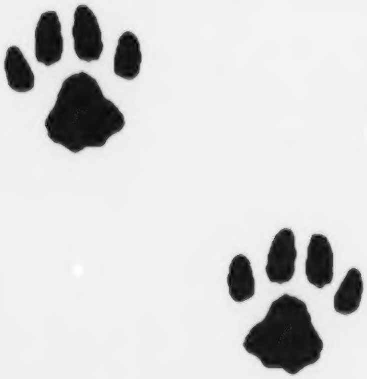

Design elements
Characteristics of position
are
assembled,
arranged,
and
positioned
to infer
meaning.

Figure 31



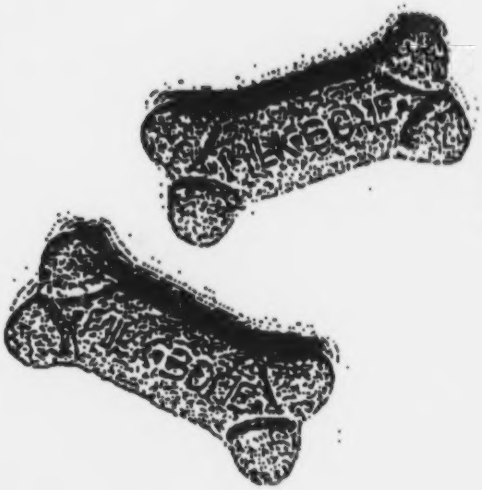
Characteristics of position

Design elements are assembled, arranged, and positioned to infer meaning.

Figure 32

7. Space

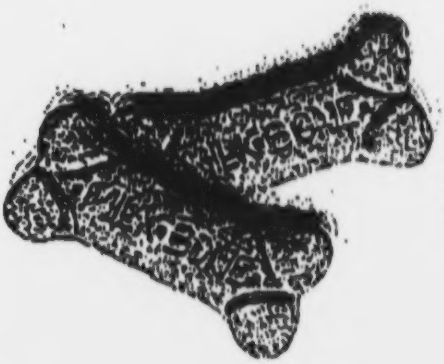
A visual field is considered flat when all forms appear equidistant to the eye and sit parallel to the surface plane of the visual field. Tufte (1990, p. 12) refers to this two-dimensional phenomenon of paper and video screen as "flatland." Space is merely an illusion in which forms are displayed at varying depths and/or angles. The greater the difference or variance in size, colour, texture, tone, etc., the deeper the illusion of space. Every point, line and shape positioned within a visual field influences and alters the spatial equilibrium of that environment. The depth of the visual field is affected when design elements encounter one another. When design elements, of similar colour or tone, are separate or touching they appear to sit on the same plane (Figure 33). However, when an opaque element overlaps another element, the opaque form appears to be on top (Figure 34). The illusion of depth is negated when transparent elements penetrate each other because their contours remain visible even though they are overlapping (Figure 35).



Characteristics of space

When design elements of similar tone are separate or touching they appear parallel to the picture plane.

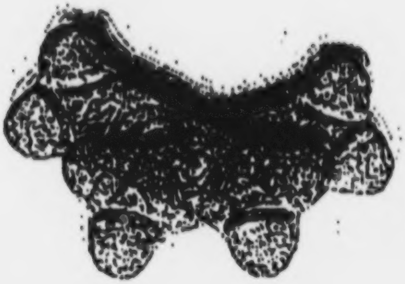
Figure 33



Characteristics of space

When an opaque element overlaps another element, the opaque form appears to be on top.

Figure 34



Characteristics of space

The illusion of depth is negated if the overlapping element is transparent.

Figure 35

Spatial depth is also indicated by differentiations between foreground and background. Point of view also affects depth perception. A full frontal view appears parallel to the picture plane whereas the illusion of rotation appears to push an object slightly back in space. Shadows provide the illusion of depth by emphasising the physical existence of the element. Motion techniques can affect spatial depth by real-time scaling of design elements, allowing the user to zoom in or out of the environment. Sound effects also reinforce the illusion of travelling in and out of a space. In addition, design elements and information can be layered in space. For example, increasing the dimensionality of a screen by using pop-up fields, and other navigation techniques increases the density of that data.

The development of virtual reality has tremendous potential for exploring spatial relationships within the interface. A virtual reality system provides the user with a fully interactive experience that includes the illusion of being inside a computer-simulated world. Instead of observing images, a user dons a helmet and data glove and actually interacts with the simulated objects surrounding him or her (Walker, 1990). Other future advances in motion include: total, seamless integration of full-motion video and live camera, animated guides and simulated agents, surrogate travel, and info-tainment systems (Mountford, 1989).

Conclusion

Provisions for a thorough understanding of the vocabulary of vision and how experienced graphic designers apply these principles to the design process are beyond the scope of this paper. What is important in this context is understanding that an individual with a keen interest in using visual communication more effectively can apply these principles and make intelligent design decisions. One of the major objectives in designing for the interface is to create a clean, uncluttered, visually stimulating appearance for an information rich screen. Tufte (1989, n.p.) recommends screens that have a high density of information, similar to traditional printed materials, such as books, maps and photographs. His suggestion for achieving this balance between simplicity of design and complexity of information is to reduce the "noise" by eliminating every pixel not serving user important data, muting minor visual elements, removing distracting patterns, ending clutter, and avoiding redundancy. Ideally, the majority of the screen's "real estate" should be turned over to user information, not to what Tufte (1990, p. 89) terms "computer administrative debris."

This visual housecleaning applies to the overall design of the application including the concept, copy, and other design elements. Rand (1970), commenting on traditional design, warns against using illustrations that do not involve aesthetic judgment and that are merely literal descriptions of reality. Some twenty-five years later, the same holds true for electronic environments. As Rand predicted "The visual statement that seeks to express the essence of an idea, and which is based on function, fantasy, and analytic judgment, is likely to be not only unique, but meaningful and memorable as well" (p. 36).

The very near future promises a new medium that has the capacity to catapult interactive multimedia beyond its existing boundaries. Computers will look different. They will be integrated into everyday lives in the form of furniture, transportation, appliances, clothing, and fashion accessories. The interfaces of tomorrow will be capable of conversation and full-motion video to guide users through the complexities of the information landscape (Oren, Salomon, Kreitman, Don, 1990). Entire workspaces will change to accommodate natural gesture and the individual style of the user. The interface will advance to be fully adjustable, supporting and conforming to the user's cognitive capacities and natural learning styles (Hicks & Essinger, 1991). With these changes imminent, developers and graphic designers must to learn to speak one another's language and in doing so, band together to design interfaces that are both visually powerful and intellectually stimulating.

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An Incremental-Transfer approach to Instructional Design

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This paper describes an instructional design methodology and the model of learning upon which it is premised. This methodology was specifically developed to assist with the design of simulations for skills training within the Australian Defence Force. The methodology emphasizes simulation fidelity definition in terms of skill process elements, performance transactions and environmental features. Instructional simulation methods appropriate to defined stages of learning are also proposed.

The incremental-transfer approach to instructional design described in this paper resulted from a 12 month study into the design of instructional simulations within the Australian Defence Force. During this study 'transfer of learning' was identified as being the key purpose of simulations and, from this, the view of learning as a process of incremental transfer grew.

The incremental-transfer approach described here addresses the process by which a novice at a skill first gains competence in familiar contexts and then in novel contexts. This scale of the learning process is particularly relevant to job-related training where minimum standards of performance under specified conditions are stipulated, but the ability to cope with unusual or unfamiliar situations is also expected.

The incremental-transfer approach has so far been applied to two training design projects. In a developmental trial of the approach a simulation was developed to assist the instruction of ILS (instrument landing system) procedures to RAAF undergraduate pilots; this trial was very successful with a clear improvement over conventional instruction being demonstrated (Wallace, in press). In an investigation of the use of embedded training techniques for teaching the use of software, the incremental transfer approach was again successfully employed to develop simulations for task rehearsal (Rzechowicz & Wallace, in press).

The aim of this paper is to briefly describe the principles underlying the proposed incremental-transfer approach to instructional design and the key steps in its implementation. Readers are directed to Wallace (in press) for a more detailed explanation of the approach.

Transfer as an Organising Concept

Transfer of learning has traditionally been seen as an outcome of learning. For example, when practice at one task is considered to lead to improved performance at another task positive transfer is said to have taken place. Likewise, negative transfer is also considered to result at times. An alternative view defines transfer as the actual process by which learning takes place.

A complete novice at a skill may be considered to have the job of transferring past learning into a new skill domain so that elements of the skill become personally meaningful. Viewed from this perspective, transfer is the process of learning and not an outcome. Moreover, if we imagine proficiency at a skill being represented by points on a line with novice performance at one end and expert performance at the other then progression along the line will occur through learning and this progression may be defined as a process of incremental transfer.

The allure of an incremental-transfer model of learning is that it may be used to provide prescriptions for instruction. These prescriptions would define the functions that instructional environments need to provide in order to support the increment of transfer being targeted at any particular stage of learning. The two aspects which require definition prior to prescriptions being formulated are: the description of learning contexts in terms of transfer, and generic stages of skill learning.

Three Dimensions of Transfer

Successful progression from a context within which competence has been achieved to a more difficult context in which competence had not been previously achieved signifies the traverse of a transfer distance. The transfer distance may be abstractly considered as the contextual differences between the two skill environments. However, a more practical definition of transfer distance is necessary for learning environments to be precisely prescribed.

The proposed incremental-transfer model adopts a three dimensional view of transfer. Any context of skill performance, along the path from being a novice to an expert, may be defined in terms of these three dimensions. The dimensions are labelled: skill process elements, performance transactions and physical environment. For example, the context of expert performance may be described in terms of each of these dimensions; the skill may be analysed as a process and a comprehensive set of elements identified, the strategies and work cycles performed represent transactions with the environment, and the environment must provide certain features for the performance of transactions to be possible.

The three dimensional definition of transfer thereby provides a tool for precisely defining the context most suited to any particular stage of learning. However, productive application of this tool will only be possible if a description is available of what role defined stages of learning play in the overall transfer process.

A Five Stage Incremental-Transfer Model of Learning

The learning of a skill may have two goals: competent performance under specified conditions, or competent performance under novel and unanticipated conditions. The first of these goals is reminiscent of educational theories which have been termed 'conservative' (Bowen & Hobson, 1974); such theories assume that required knowledge may be defined in advance of learning. The second of the goals is more akin to the theories Bowen and Hobson (Bowen & Hobson, 1974) refer to as being 'liberal'; these theories argue that abilities to enquire, explore and adapt should be developed in learners.

While educational theorists continue to argue over which of the conservative and liberal schools is the preferred, the learning of a skill may well require both approaches. Indeed, in many job-related skills a certain minimum standard of performance under specified conditions is necessary for safety certification, while the commonsense to adapt to variations in conditions is also expected.

Near transfer has been used to describe situations where learning is required to be transferred to a context very similar to that in which experience has already been gained (Clark & Voogel, 1985). When the context of graduate performance can be reliably predicted then near transfer, and conservative theories of learning, may be the most appropriate.

Far transfer has been used to describe situations where transfer to novel contexts is required (Clark & Voogel, 1985). Where the context within which graduates are to perform a skill cannot be reliably defined then far transfer, and liberal theories of learning, may be the most appropriate.

The incremental-transfer model views near and far transfer as being respective goals of the final two stages of skill learning. Preceding these are three stages which prepare learners for near transfer practice. The first stage is skill initiation, during which the skill domain becomes meaningful. The second stage is skill paragon formation, during which a mental model of an individual paragon of skill performance is constructed. The third stage is initial skill practice, during which learners first apply and modify skill paragons.

In summary, the incremental-transfer model defines five stages of transfer: skill initiation, skill paragon formation, initial skill practice, near transfer practice, and far transfer practice.

An Incremental-Transfer Instructional Design Methodology

An eight step methodology has been proposed for the design of instruction consistent with an incremental-transfer model of learning. The eight steps are: training problem analysis, skill analysis, instructional strategy, transfer path derivation, learning event specification, statement of requirement, system specification, and implementation guidelines.

The proposed design methodology was specifically developed for the context of training projects within the Australian Defence Force and places emphasis on matters such as a formal statement of requirement (for the purpose of calling for tenders) which may not be relevant in many civilian situations.

The step of 'learning event specification' is worthy of some elaboration. A review of modern theories of learning was used to develop lists of general functions which simulations should perform if they were to support transfer during each of the defined five stages. As a result, five types of simulation were defined: Expository Examples, Inquisitory Examples, Guided Convergent Practice, Independent Convergent Practice and Independent Divergent Practice. These respectively match the five defined stages of transfer, i.e. skill initiation, etc.

A brief description of how required ILS procedures simulation functions in support of RAAF undergraduate pilot training were defined during development of the design methodology may provide a practical illustration of the application of incremental transfer.

A review of current ILS procedures training, in terms of the incremental-transfer model, revealed potential problems during the stages of skill paragon formation and initial skill practice. A single simulation event comprising two parts, one addressing skill paragon formation and the other initial skill practice, was assessed as being adequate to overcome the potential problems. In accordance with the above described simulation types, the single simulation event was to provide inquisitory examples and then guided convergent practice.

Competent performance during near transfer was analysed and the context for this performance described in terms of the three dimensions of transfer. During simulation design, the dimension of skill process elements was firstly addressed with only elements unfamiliar to learners being included in the context descriptions for skill paragon formation and initial skill practice. Next the transactions identified through analysis of near transfer contexts were modified to match the two stages to be addressed by the simulation event. Finally, the environmental features associated with near transfer performance were modified to allow both instructional functions and performance transactions appropriate to the two transfer stages to be performed.

The result was a functional description of the required simulation and an instructor guide. As mentioned in the introduction to this paper, instruction designed using the incremental-transfer approach was compared with conventional instruction and found to be superior in supporting transfer (Wallace, in press).

The production of a functional description of the required simulation is especially important. Historically, statements of requirement for simulation systems have focussed upon engineering concerns and neglected instructional issues (Hays & Singer, 1988). The incremental-transfer approach avoids this pitfall by stating the instructional functions which the simulation system must support and the context the simulation is to provide in terms of transfer dimension characteristics.

Conclusion

The approach to instructional design described within this paper is aimed at implementing an incremental-transfer model of skill learning. This model of learning views transfer as being the process by which learning occurs. Consequently, the job of instructional design is to create environments and activities which promote efficient transfer.

Prescriptions for desired transfer are provided within the design methodology and draw upon a broad range of learning theories. An underlying assumption of the methodology is that both near and far transfer are valid goals of learning and, therefore, that theories dealing with each of these goals are relevant.

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Telecommunications Impacts on Interactive Multimedia

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Advances in multimedia workstations, software systems, storage and user interfaces which allow the presentation of multimedia information have produced an environment in which interactive multimedia systems are developing at a rapid pace. Most current systems are local in their service range, but there will be an increasing demand for long distance multimedia communications. Multimedia communication issues are discussed in this paper. Present-day networks go some way towards satisfying the service support requirements of multimedia, but the future Broadband Integrated Services Digital Network (B-ISDN) will ultimately have the capacity and flexibility required to ensure multimedia applications are completely freed from geographical restrictions.

Recently, there have been considerable advances in the components necessary to permit the development of powerful multimedia applications. These have occurred in the areas of hardware and software, and, to a lesser degree, standards.

Hardware developments have led to the ready availability of 24/32 bit colour display boards for PCs/workstations, allowing the presentation of high quality colour still and moving images, and graphics. "Video in a window" boards complement this by permitting real-time video to be presented with other information in an integrated manner. The capability to reproduce high quality sound is also becoming more common. At a more fundamental level, the processing power and backplane speeds of computers permit the manipulation and transfer of large amounts of information, including motion video. Rapid, efficient image compression is possible in a single inexpensive chip. Plug in boards that implement standard motion video coding methods in real time on just a few chips are also now available.

Complementary to advances in PC/Workstation hardware are the software developments that allow these hardware capabilities to be exploited. These include the development of composite documents which combine media (e.g. text and graphics) in the one document. This now allows desktop publishing in which one can actually see what is to be printed. It is also now possible to paste, not just line drawings, but high quality images into other documents, providing a new flexibility for desk-top publishing and document preparation. Software systems are emerging that permit shared working by two or more users on the one document. Co-workers can therefore edit the same document interactively and simultaneously. Hypermedia systems offer the potential for information presentation in the most efficient and flexible manner possible in any given application by providing a hierarchical and cross-indexed structure to complex multimedia documents. A recent advance has been the emergence of real-time information handling software systems suited to the manipulation of real-time information such as audio and video, providing the capability to manipulate (record, store, play, edit, copy, paste) these in the same way as ordinary documents.

Standards are also beginning to be developed to permit the widespread exchange of multimedia information. The ISO is studying stored audio and video systems, database access, multimedia/hypermedia representation, computer graphics systems and others. CCITT covers telecommunication service definition, network support, signalling and coding of communicative audio and video. Relevant activity in CCIR includes the television service definition and CMTT covers standards for coding of broadcast services for transmission.

While some of this standards activity concerns familiar applications, new and vastly different applications will emerge from some of the computer-oriented developments. Initially, these will be confined to local applications, using local storage devices and proprietary interfaces and storage formats. At best, some of these could be shared over a Local Area Network (LAN). Increasingly, though, there will be pressure to extend the range of multimedia applications so that even sophisticated multimedia applications, like hypermedia documents, can be transferred across the country and around the world, and information in a variety of formats can be accessed from diverse and remote locations. There will, therefore, be increasing pressure on public telecommunications network providers to support this type of communications.

Multimedia Communications

The principal features of multimedia communications which impact directly on the telecommunications network are:

- *Range of service types.* The support of different media (audio, video, data, text, graphics) in a range of different configurations will demand of the network flexibility unlike anything seen previously. A given service may have to be delivered at a range of qualities (e.g. videoconferencing at a range of different picture qualities). Different media may be better suited to different network qualities of service. Some services will be interactive, others communicative or distributive. Some will be symmetrical (e.g. two-way videophone) and others asymmetrical (e.g. request for video segment from a database).
- *Association between services.* Multimedia information implies some form of linkage between the component parts of the application, and this requirement may impact significantly on the structure and functionality of a telecommunications network. Most obvious, perhaps, are the synchronisation requirements between associated audio and video channels, or between stereo audio channels. Other "links" include tariffing arrangements for a single call comprising several components, and the call admission (i.e. allowing establishment of the call) and monitoring of the ensemble. A particularly complex issue arises in the support of hypermedia, where a request for information over one connection could initiate a completely new connection.
- *Multipoint.* The expansion of multimedia applications beyond local use (on a self-contained PC/workstation), by permitting long distance communication, opens up

the possibility of multipoint multimedia applications for negotiation, shared working, telecommuting, etc.

- *Distribution of information sources.* Many issues arise regarding the location and distribution of information sources once network access is available. For example, access to vast central or distributed databases can be provided over the telecommunications network, and the range of multimedia information used in a particular application might be distributed throughout the network instead of being localised on the one CD-ROM in the local application.

Clearly, communication networks must provide great flexibility to support the diverse range of services, rates, qualities, configurations, etc. The networks will also have to take account of the inherent link between the service components to ensure that relevant timing constraints can be satisfied and to control the tariffing arrangements for these complex services. Many other issues arise concerning the control of multipoint multimedia applications and the management of information distributed throughout the network.

Multimedia Communications — Network Options

Recent developments in telecommunication network evolution are taking us into a future with vastly more transmission capacity available for transmission of a range of digital information.

Integrated Services Digital Network (ISDN)

The ISDN offers much greater digital capacity than has been available generally before. Multiples of 64 kbit/s are available from this network, and this is sufficient to support limited shared workspace applications, interactive access to image or text/image databases (with transfer times of a few seconds) and even some lower quality video applications. Large files and complex documents could be exchanged over this network much faster than by the traditional low-cost modem but, for many multimedia applications, the network would remain a bottleneck to response time.

For some multimedia applications, standard transmission methods have been defined that will support combined data, audio and video over the ISDN. CCITT Rec. H.221 (CCITT, 1990) defines a multiplexing structure for several 64 kbit/s channels used to support audiovisual services defined by other CCITT Recommendations. However, this structure is not intended for universal support of multimedia services.

Metropolitan Area Networks (MANs)

Offering greater capacity than the 64 kbit/s based ISDN, MANs are intended principally to support LAN-LAN interconnections (Montgomery, 1992). Telecom Australia's "FASTPAC" service will be one of the first of these available in the world, and is due for commercial release by the end of 1992. Backbone rates of this network are in the range of tens of Mbit/s to over 100 Mbit/s. Common interfaces will be the main throughput limitation since they will conform to standard LANs such as Ethernet or Token Ring (i.e. of order 10 Mbit/s).

By providing transparent interconnection between LANs, these networks will provide the infrastructure to allow remote interactive multimedia applications to flourish. The remote systems will appear to be connected to one very large LAN, and the high capacity will ensure that reasonably fast response times are achieved. The MAN standard (IEEE 802.6) is based on fast packet switching methods in which LAN packets are split into a number of segments for transmission and switching. This means that a wide range of service rate demands can be accommodated and that connection control for different applications can be integrated. MANs are seen as a major stepping stone towards the B–ISDN.

Broadband Integrated Services Digital Network (B–ISDN)

The high speed networking capabilities of the B–ISDN are complementary to the requirements of multimedia services and will enable a variety of new, innovative applications across all market sectors. The B–ISDN, to be introduced in the later half of this decade, will offer User Network Interfaces (UNIs) of 155 or even 620 Mbit/s, sufficient to support even digital High Definition Television (HDTV) applications (Day, 1990).

The use of Asynchronous Transfer Mode (ATM) (again packet–based, using short, fixed length packets called cells) as the transport mechanism for the B–ISDN is intended to provide flexibility for the carriage of all known, as well as unforeseen, services. The cell–based transport allows adaptation to required service rate requirements and accommodates asymmetrical bandwidth needs easily. Furthermore, low level signalling capabilities permit multiplexing of the different components of a multimedia connection at the cell level. That is, each media has its own cell stream, permitting great flexibility in the routing of the individual media within the network, as well as matching of the cell stream attributes (such as quality of service, and therefore cost) to match the needs of each medium. For example, file transfer data may be much more tolerant of errors or cell losses, because of high level error control, than real time video services.

A discussion of the B–ISDN and its suitability for the support of multimedia is provided in (Biggar, 1991).

B–ISDN Support of Interactive Multimedia

Assuming that the B–ISDN is the long term home of multimedia communications services, the following subsections provide some discussion of the various issues that arise when considering the demands of multimedia services on the network.

Service Component Synchronisation

One of the most obvious requirements for multimedia services is the need to ensure appropriate timing relationships between the components of a multimedia service if they follow paths within the network which could lead to differential delays. This consideration is of particular importance for real–time interactive applications.

Examples of multimedia applications in which synchronisation will be most important include audio/video synchronisation for both distributive and communicative video applications, shared workspaces in which it is essential that the same workspace is seen simultaneously by each participant.

Multipoint Working

Extension of multimedia services beyond the self–contained PC/Workstation or LAN environment will permit access to remote and diverse databases, and communicative multimedia between sites. One of the major capabilities, however, will be the ability to involve multiple participants. This is already proving to be one of the most important features of the videoconferencing service.

A range of issues arise when considering multipoint, multimedia service capabilities. Some of these are:

- *Multipoint facility*. Existing multipoint capability (for audio– or video–conferencing) is provided by a central bridge that mixes the signals as appropriate and presents the result to each participant. It is already recognised that new possibilities are available in the B–ISDN. For example, the video signal could be multicast to all receivers, while the audio component only is mixed at a bridge. The diverse range of components in more complex multimedia communication sessions must be considered with regard to how the multipoint capability should be provided and how the components interact in a multipoint environment.
- *Dissimilar terminal types*. In a conventional multipoint videoconference, all participants have essentially the same capabilities and requirements (with the exception of a controlling chairman). In the more diverse world of multimedia, however, some of the "participants" could be databases called into the "conference" by one or more of the other participants. The implications of this must be considered. There will also be diversity in terminal capabilities, some not even supporting all the media. How will networks know of the capabilities of the various terminals, and how will they decide what is and is not a useful connection? Methods of handling this situation in a multipoint environment must be considered.
- *Shared control*. In a multipoint videoconference involving just audio and video media, transfer of "control" between participants is relatively straightforward. Either a chairman determines who is seen and who can speak, or a bridge can make the decision according to the present speaker (voice activation). It has already been noted that other possibilities exist once the B–ISDN is used for service delivery, since more individual control of who is seen should be possible. In a more complex multipoint multimedia session, however, there may be greater need for interaction and individual control. For example, in a shared workspace application, where a document is being discussed and edited jointly, several participants may wish to initiate actions on the workspace without (knowingly) having to gain formal control of the cursor. All requests for action cannot be carried out in an ad–hoc way, though; two instructions could be queued for processing, the first of which changes the workspace upon which the second acts. Mechanisms for negotiation and allocation of control of the workspace are therefore essential, and these must be easy to use, not significantly different to the way the operations would be carried out if working solo.

Other implications will emerge once the diversity of multimedia applications are considered in multipoint environments.

Service Integration

Because multimedia applications encompass not only different media but also multiple grades of the same media, there is a clear requirement to rationalise the various media into common structures, minimising the terminal complexity and maximising its capability to access diverse service types.

The most obvious application of this concept is in the most demanding service type — video. Work is already well–advanced in the definition of hierarchical, or layered, video coding architectures that allow interworking across a broad range of services.

This will mean that one terminal can accept and present a video signal almost independently of the original source and transmitted resolution, frame rate, etc. (Scott, 1990). Complementary studies are required on integration of the various other service components.

Additional Presentation Issues

Presentation of the various media components of a multimedia application to a user in a coherent and easily assimilated fashion has already been identified as an important area of ongoing study. However, the provision of multimedia services via a communications network introduces additional issues to be considered.

These issues include: how to provide control of the connections, which may be to different sites, in a manner that is "user friendly"; what tariffing feedback should be provided to allow the user to monitor and "control" the price paid for a particular multimedia connection; and how control of a multimedia connection is to be divided between the user and network operator, and whether the arrangement should vary between media.

Media Conversion/Translation

The proliferation of a diverse range of terminals with differing capabilities will introduce interworking issues much wider than just the type of coding method to be used. Terminals able to use different subsets of the possible media will exist, and these may be used to access the same data or even be involved in a multimedia multipoint conference connection. This implies the ability to perform conversion between the media.

An example where this capability might be required is the interrogation of a text-based electronic mailbox via an audio-only telephone. If this capability is to be permitted, then text-to-speech conversion will be required somewhere in the link. Another example might be the inclusion of a participant with videophone capability into a multimedia conference where computer graphics files are being exchanged. In this situation, the means to convert the graphics image to standard video signal format would be required.

Investigations are required to determine the range of media conversions which may be required, the feasibility and importance of providing them and the important question of where the conversion should occur. Must it be provided within the network or is it a terminal/database issue?

Interworking Across Networks

During the transitional period as the B-ISDN is adopted, and possibly for some considerable time afterwards, some elements of the communication links needed for the support of multimedia applications may be provided over different networks. The various constraints of Metropolitan Area Networks, Narrowband-ISDN, various LANs, etc. will mean that interworking becomes a serious issue.

While interworking across networks is often considered to be solely a network consideration, many service issues also arise, such as how much of the multimedia multiplex should be passed through a network constrained by bit rate or functionality. How much of the decision-making process should be given to the user, and for how much will the network intelligence be responsible? How should a multipoint connection be implemented if one of the participants can only be contacted over a low rate network or on a terminal of limited capability (single media)?

Integration of each of the various media is also important in this situation since, for example, the layered "Universal Video Coding" architecture would permit lower rate (and quality) subsets of a video signal to be passed over a rate-constrained connection (Tan, 1991).

Conclusions

We are now seeing dramatic advances in computing capabilities, and in particular personal computers and workstations, that mean that new forms of information manipulation and presentation become practical. Associated developments in software systems and "hypermedia" applications are providing maximum potential for use of information in a way that matches the needs of the user and the possible media. A large demand to provide complementary communications capabilities can be expected to free these new information systems from constraints of local access.

At the same time, switched network capacities are increasing (and developments in other areas such as signal processing occurring) to the point where we can consider support of more traditional media, such as television and high quality audio distribution, that has not been possible on the public network in the past.

These developments indicate the need for an overall framework for the support of these services under the banner of "multimedia" (which can include single media as special cases). Identification of the special requirements of these services, how these can be satisfied, the impact on the network and the most effective means of presenting the service to the customer are important areas for further investigation.

This paper has provided an initial view of the impact that multimedia services may have on communications networks, what the network options and evolutions may be, and a more detailed look at some of the issues that must be considered as the B-ISDN evolves to support this important service category. The B-ISDN has the transmission capacity and flexibility suited to the support of all the components of a multimedia connection, and should be able to deliver very fast response times and a high perceived performance (potentially indistinguishable from operation with local peripherals). However, there remain several important areas to be studied to ensure that this vision can be realised.

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The Interactive CD— Learning and/or Entertainment?

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Low cost home entertainment equipment that integrates a compact disc (CD) player with a personal computer offers great potential for bringing truly interactive multimedia into the student's home. This paper describes a project carried out by the School of Engineering and the Media Services Unit at the University of Southern Queensland, to present an engineering unit of study using Commodore CDTV. The process of scripting and producing an interactive multimedia program is discussed and the scripting documentation that has been developed is described. In addition to the primary educational content this CD contains several features that play important support roles. These are outlined and their educational role discussed.

"Remember what business we are in", the words of Rockley Miller, editor and publisher of Multimedia and Videodisc Monitor (in Sheehan, 1991), are a constant reminder that multimedia is a tool for communication rather than an end in itself. The exciting possibilities presented by multimedia systems and the myriad of equipment that usually accompanies it must not cloud our educational purpose. As educators, educational technologists and instructional designers we can embrace the thrill of the technology while remembering what business we are in.

As discussed by Johnson (1987) current investigations into the role of technology in learning and education draw the same conclusions as studies into mediated instruction over the past three decades, that is, it is the design and context of the instruction that is the vital factor in effecting the learning outcome.

Since 1976, the University of Southern Queensland has sought ways to meet the challenges presented by providing distance education. In the engineering field this has centred around effectively presenting the physical hardware of engineering, highlighting the underlying physical phenomena and developing the related mathematical models.

Because of the diverse spread of engineering students from remote mine sites to ships at sea, from 9.00am to 5.00pm workers to shift workers, a guiding principle in the search for effective delivery has been that the methods adopted must be available in the student's home and at a time that suits the individual student.

Over the years attempts have been made to improve delivery using 8mm film, videotape and videodisc. Film, while interesting, led nowhere because of the relative difficulty of editing film with sound, the cost of multiple reproduction and students' limited access to projection facilities.

The widespread presence of VCRs in private homes overcame the access limitation. This medium proved relatively easy to edit and the cost of multiple reproduction was quite acceptable. Although videotape had the capacity to serve as the primary delivery mechanism, it was invariably used only as a supplement to conventional printed material. Also, despite the stop/start/replay features of the VCR the students tended to use the videotapes in a passive, linear way.

The School of Engineering produced a trial videodisc (Pemberton, Taylor & Tolman 1985) and while the medium itself allowed a considerable improvement in pedagogical method, the equipment was complicated, prone to interfacing problems and too expensive to be afforded by individual students.

Interactive CD technology appears to have overcome many of these limitations. Many of the phenomena treated in Engineering are dynamic and/or three dimensional; often these phenomena are very difficult to represent in the conventional print media, however it is anticipated that interactive CD has the capacity to do a much better job.

The old adage:

> I hear and I forget
>
> I see and I remember
>
> I do and I understand

still has firm foundations in learning theory. From Dale (1954) to recent cognitive science based studies (Taylor 1985: Clarke 1992) the real life experience is a vital component of empirical learning. The external engineering student is generally surrounded by this experience and the educational challenge is to associate the fundamental physical phenomenon and mathematics with that reality.

Another aspect is that for many external students the breadth of their real life experiences is limited to the demands of their particular job, the educational task is to broaden their experience in areas that would otherwise be unavailable.

Interactive Multimedia Project

In association with the Queensland Department of Primary Industry, the University of Southern Queensland is undertaking the development of interactive CD programs. The prime objectives are:

- to develop the skills required to design, author and produce higher level educational material:
- to investigate the impact that different levels of image quality have on the learning effectiveness of the presentation:
- to explore the different facets of the interactivity and assess how effectively these features function in engineering education.

From the beginning, this project has been concerned with exploring learning processes and activities that will best suit the characteristics of the subject area, in this case engineering. As features were identified and developed the technology and authoring software were challenged to deliver the goods. This approach released any inhibitions the instructional designer and content expert may have had in their vision of the potential of the medium.

The process

The first step is to define the learning objectives.

The next step, developing a concept map of the factors involved in reaching the objectives, serves several purposes. First, it establishes lateral thought processes, helping to break down the hierarchical structures that are usually embedded in traditional approaches to course delivery. Second, it can result in an overview based on quite abstract concepts, which in turn generates fresh ideas. Third, it provides a visual picture for identifying relationships between the components. Concept mapping is essential for establishing the style of thinking conducive to designing for the multi-layered, multi-directional characteristics of interactive multimedia.

The steps that follow consist of identifying the content, establishing content clusters, developing a content map and identifying interactivity links. These steps are generally commenced in this order but they do not finish before the next one begins.

Identifying the content will start to trigger ideas for the audio script, specification of graphics, identification of possible interactivity paths and identification of desired accessory features. As the content clusters, map and links are established these concrete aspects will continue to grow so the instructional design and development process takes on a spiralling character.

Features were identified that the student would need to access from any point in the course. These included, glossaries of terms and symbols, banks of laboratory demonstrations, field examples and data such as mathematical formulae. Engineering expert systems and simulations were included, a calculator program and word processing program supporting a notebook facility and all of the conventional printed external notes were included.

A course stream option enables the student to select the appropriate level of study to be followed for example, undergraduate diploma or degree or post graduate diploma. A language option provides additional support for international students and offers potential for overseas marketing.

No hard barriers have been included in any stream, only guide posts, so the student is free to explore the learning material in the way best suited to the individual's interests and needs.

All of the information stored on the CD presents a rich collection of resources that can also be used in the traditional lecture setting.

Documentation

To keep track of information some form of record has to be kept. For this project the concept map consisted of bold, freely written topics and ideas scattered over sheets of paper. Coloured fluorescent pens were used to highlight identified content clusters.

Specific content scripting could then begin for each cluster, working through the levels and branches of information. This is aided by the use of a script proforma which provides for screen graphic requirements, audio, hot spot identification, video segments and programming pathway identification.

A content map can be developed while scripting is in progress. This is usually done in a draft format to allow for the numerous changes that take place as the script is refined. As the content map shows every screen with its unique number, graph paper makes the task a little easier. The content map makes it easier for the programmer to translate the content arrangement into the computer program.

The latest version of the script proforma includes areas for recording the specific interactivity pathways from buttons and hot spots. There are also areas for the audio script, description of video segments, common usage identification and comments to the programmer.

CDTV (Commodore Dynamic Total Vision)

At the time of initiating this project the Commodore CDTV was the only commercially available system that met the guiding principle of being available for the student in his/her own home.

It has the technical capability to present truly interactive multimedia. Specifically it has the capacity to store:

- up to 100,000 A4 pages of text or
- up to 65 minutes of 1/4 frame video or
- up to 17 hours of AM quality audio or
- up to 7000 colour still pictures or
- up to 660 Megabytes of computer program or
- any combination of the above

Further it can access this stored data in less than 0.8 second. Designed as a home entertainment system presently retailing at under $A900 it is both affordable and easy to set up, requiring only a TV set and power. The fact that it can also play CD audio and video and, with additional accessories, can be used as a personal computer, greatly increases the probability that it will rapidly become a household item. While this project centres on the CDTV, it is seen as only one of a new genre of equipment.

Compression

While the 660 megabyte capacity of a CD may seem a lot, expressed in terms of conventional audio and video requirements it is very limited. For instance it gives only 60 minutes of conventional high fidelity audio and if used for video it would provide a mere 30 seconds playing time. How then is it equal to the task of presenting interactive multimedia? The secret lies in compression.

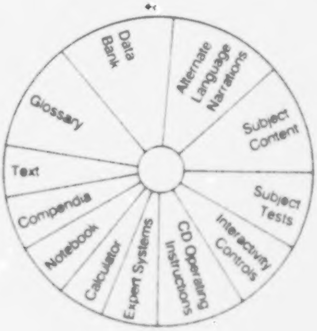
Normal high fidelity audio requires the sound track being sampled 44,000 times per second and recording over the frequency range 20-20,000 Hz. By sampling only 12,000 times per second and recording only over the 100-5,000 Hz frequency range the audio capacity of the disc can be extended to 17 hours.

Conventional television presents images at a rate of 25 frames per second and each frame has potentially 16,000,000 colours. By restricting each frame to 4,096 colours, reducing the frame rate to 14 frames per second, and then not recording the full frame but only the changes in image from the previous frame, and physically compressing each image to 1/4 screen, the video capacity can be increased to 65 minutes.

This general philosophy runs throughout the CD. In computer graphics and animations, as with the audio and video, the minimum resolution and number of colours are a compromise between storage limitations, processing speed and definition of image.

Content of the CD

This prototype CD is intended to trial many of the features and techniques expected to be required of a medium that is to serve as a primary delivery medium.



Subject Content

The primary content of this CD is of course the educational subject matter. The CD presents the subject matter and then tests the student's grasp of that knowledge. Recognising that different people learn in different ways, considerable emphasis has been placed on using visual images, text and narration to explain and develop the subject matter. Because engineering subjects lend themselves so well to visual approaches this prototype CD deliberately explores a variety of visual techniques including graphics, animation and metamorphosis.

Alternate Languages

Technically it is relatively easy to provide the narration in different languages on the CD. In this respect engineering is quite interesting. Whereas most tertiary disciplines have strong cultural connotations, engineering tends to be culturally neutral. The hardware of engineering is deliberately international, the underlying physical phenomena are universal and the mathematics know no national or cultural boundaries. And, because Britain and subsequently the United States of America, have so dominated engineering development, the jargon of engineering is in English. In many of the Asian nations engineering education is conducted in English and even where the national language is used the technical terms are expressed in English.

It follows that only minimal modification of the graphic images is needed to match the different languages. The mathematical symbols and conventions are the same and it is quite acceptable that on-screen text be in English.

The Notebook

It was felt that once a student "got on a roll" with this medium any need to turn to a pencil and paper to make notes, or jot down ideas would seriously interrupt the flow. For this reason a Notebook has been included. It can be accessed at any time by clicking on the Notebook Button and when finished returns the student to the same point in the program. The Notebook provides all the functions of a simple word processor including the ability to take off a hard copy. Because this CD is designed to be used via a TV set rather than computer monitor the Notebook uses only 38 characters per line.

The Calculator

Engineering studies regularly require the student to carry out calculations. In order to avoid any interruption to the student's flow of thought a calculator has been incorporated into this CD. In this prototype the calculator is limited to the simple arithmetic functions but in later versions it will have full scientific capability.

Data Bank

The subject content of an engineering unit never stands alone, it invariably draws on a wide variety of data ranging from the physical properties of particular metals and alloys to the geometric sizes of specific products such as BHP steel beams. This CD includes a bank of all of the data needed to support its subject content.

This data bank can be accessed at any time simply by clicking on the Data Button. Any data selected can be transferred directly back to where the student was working and incorporated into that activity. The data can even be incorporated into the Notebook or the Calculator.

Glossary of Terms: Hot Words

Engineering uses many technical terms, it attaches very specific meanings to even common words, its mathematical models incorporate many symbols each of which has a precise meaning. A significant part of engineering education rests in becoming familiar with these words and symbols.

For this reason a glossary of words and symbols has been incorporated on the disc. It can be accessed in two ways :

1 the Glossary button will lead to an alphabetical listing of the words/symbols and their associated meanings.

2 where such words or symbols appear on screen they are 'hot' and when clicked will bring up a complete definition.

It is thought that this hot word function will avoid the student glossing over unfamiliar words and instead seek their exact meaning.

Interactivity

If the images and narration are the flesh and blood of the CD then the skeleton and brain are the linkages that define the interactivity. This interactivity, in its many forms, is included on the CD as a set of logic data files. It is these files that determine what action will occur if, for example, a hot word is activated or what feedback will be given to an incorrect response in a test and so on.

Compendia of Resources

The laboratory demonstrations and field examples on the CD are organised in such a way that they can also be accessed and used as a compendium of resources. For instance, while the subject content might include 10 examples of actual stress concentrations, a student wishing to examine a broader range could use the compendium which might contain a further 30 examples.

This compendium has two major intended uses in addition to the above. First, it can be used by a lecturer/tutor to support and supplement a conventional face-to-face class. Second, it can be accessed randomly to build up individualised tests.

Text

It is considered that, although this medium has the technical capability to serve as the sole educational medium, there will be a cultural time lag before it will be accepted as such. During this interim period there is no doubt that the School of Engineering will continue to produce conventional printed study materials for its external students. However, as a step towards bridging this dependence on printed material this disc includes the whole of the conventional printed study materials as an ASCII text file.

The students can display this as text on screen or take off a hard copy as they wish. It presently costs about $38 per student unit to print each set of study materials and a further $9 to mail them. The comparable costs for a CD are $1.40 and 85 cents. It is expected that this financial incentive will lead to the early demise of the conventional study materials once CDTV and its kindred devices are commonly available in Australian homes.

Operating Instructions

The method of using this CD is exactly the same as that for any standard CDTV disc. However, because this CD contains so many special features an introductory segment is provided which lists these features, shows how they can be accessed, and explains their uses and limitations.

Screen Design

It was important that the student operational interface with the program be as transparent as possible. The mechanisms by which the student moves through and across the course material must not interfere with the student's concentration on the learning content.

To this end controls and functions that had to be available at all times were identified. Beside the A and B buttons provided on the remote hand control unit, four program control functions and five facility functions were identified.

The design and operation of these controls had to be consistent. The major control buttons always have the same appearance and occur at the same locations on the screen. Hot words and symbols are always identified in the same way. The colours, text style and function symbols must also be consistent and sub-topic screens are always distinguished from topic screens in the same way.

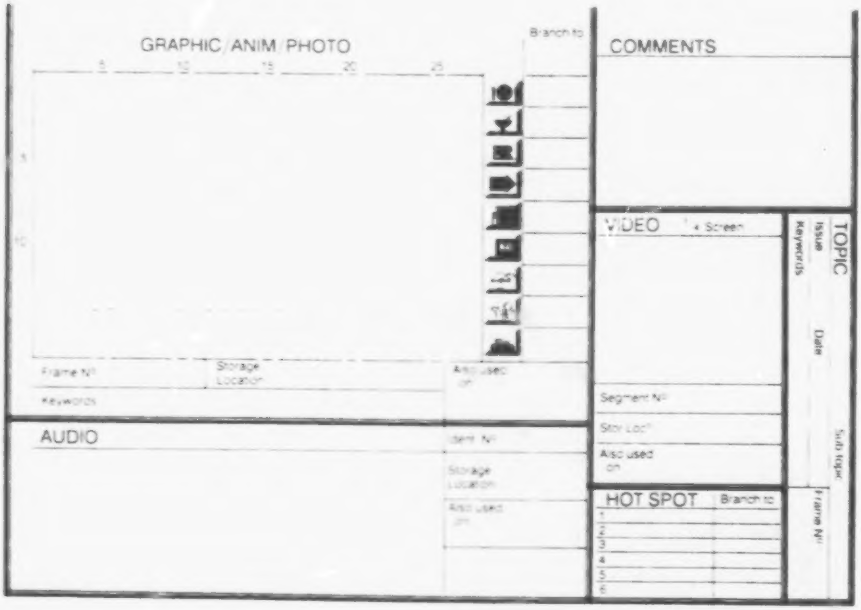
The selection of colours for the generic screen design had to take into account compression and disc storage space requirements.

As this pilot CD project was based on the use of the home television, screen design had to also be concerned with the readability of text and the resulting limited number of characters possible on the screen.

A consistency of approach was necessary for the presentation of 1/4 screen pseudo-video, metamorphosis and graphic techniques. Another operational convention that was adopted was a zoom feature. Clicking on a wide shot illustration would result in progressive closer shots.

With all of these issues in mind, the general aesthetic considerations for screen design were put into the hands of a graphic designer.

Scripting Proforma
Scripting multimedia is a significantly more complex task than writing the script for a conventional linear video. In the course of writing this script a proforma has gradually evolved to present all of the necessary information. While no doubt it will continue to evolve, perhaps a description of this proforma as it is now, will help to explain the information that must be given in a multimedia script.


GRAPHIC/ANIM/PHOTO
5
10
15
20
25
Branch to
COMMENTS
VIDEO
¼ Screen
TOPIC
Issue
Keywords
Date
Sub topic
Frame No
Frame No
Storage Location
Also used on
Keywords
Segment No
Stor Loc
Also used on
AUDIO
Item No
Storage Location
Also used on
HOT SPOT
Branch to
1
2
3
4
5
6

Graphic Box
The largest feature on the form is the graphic box. It is distinguished by a 29 x 17 grid. Because CDTV displays on a conventional TV, on screen graphics are limited to 29

characters across and 17 lines down the screen. Beyond these limits on screen text becomes difficult to read. This grid assists the writer to design screens within these limits.

The extreme two right hand columns of the screen are occupied by button symbols. These are the buttons that control the routine interactivity and give access to the facilities incorporated in the CD.

Immediately to the right of these buttons is a further column labelled "Branch to". This is used to specify the frame that the program will move to if the corresponding button is clicked. Note that the top button, labelled B, is outside the limits of the screen. This is the B button on the CDTV hand controller.

The box at the bottom of the graphic box contains space for recording the storage location, frame number and keywords. Every asset, be it a computer graphic, an animation, a video still, a video sequence or even an audio sentence has its own unique identifier, its frame number. It is through this identifier that the asset is linked to the overall program.

The storage location reference is used simply to record where the original asset is stored, for example, video tape number and time code or computer disk and file name.

This box also contains space for keywords. The various assets can be accessed independently through a keyword search facility called a compendium of resources. It is here that the writer specifies the keyword descriptors for each asset.

Audio Box
The audio box, like the graphic box, has space for a storage location and a unique identifying number. It is here that the writer defines the narration/sound effects that are to accompany that screen.

It is not unusual for the one segment of narration/sound effect to be used in more than one place in the program. In such cases only the unique identifier is entered here.

Hot Spots Box
In addition to the buttons mentioned earlier, the writer can define certain spots on the screen to initiate interactivity. These may be features on graphics, on-screen text or symbols. The writer must specify the unique identifier of the frame to which the program is to move if the hot spot is clicked.

Video Box
Here any video segment is defined. Again it has its own unique identifier and the writer can specify where on the screen it is to be displayed.

Comments Box
Finally there is space to give special advice to the camera crew, graphic artists, animators and programmer.

"Also used on"
A feature in the graphic, audio and video boxes that needs explaining is the "Also used on". Many of the graphics and video clips and even some of the audio segments

can be used more that once in an interactive program. This multiple use of assets carries with it a distinct probability that at some stage during the overall development of the program, a modification will be made to a particular asset to better suit it to one of its uses without realising that the change also makes it unsuitable for one of its other uses. The "Also used on" alerts the writer to all of the uses of a particular asset and so hopefully guards against such situations.

Conclusion

The project described in this paper is only the first step in a larger project. It was undertaken in order to learn how to script and produce interactive multimedia and to assess the capabilities of Commodore CDTV to meet engineering education needs.

It has been a valuable exercise. The team has developed competence in all of the relevant areas. Most importantly the equipment has been able to deliver everything asked of it so far. At this stage it is the imagination of the authors, rather than anything else, that is the limiting factor.

The next step of the project is to produce a CD that contains one whole unit of study and trial it with students. That stage will also evaluate the costs of producing the CD.

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The National Educational Communications Framework: Analysing the question of common technical specifications

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Recent investigations by the Australian Education Council's Working Party on a National Educational Communications Framework included specific reference to the question of "common and agreed national technical specifications for telecommunications and computing equipment to be used in the delivery of open learning". This paper analyses two case studies, video conferencing and computer mediated communications, which give an illustrative perspective on the role of technical specifications.

Video conferencing in Australia lacks a "common technical specification", and as a result proprietary protocols are dominant and sites are not able to communicate to all other sites in Australia. By contrast, in computer communications via AARNet, the Australian Academic and Research Network, key functions are independent of proprietary protocols and universal interconnectivity is feasible. Both cases suggest that the impact of the presence or absence of "common technical specifications" is relatively minor, compared with larger impacts arising from other issues. The role of both media in open learning and distance education is likely to be developed best if we place importance upon personalised support and interactions with students, and on regionalised delivery models, in contrast to models which are based on autonomous, tutorless study. If the National Educational Communications Framework directs its attention towards the latter model, and its associated emphasis on national television broadcasting, it is unlikely to achieve any significant promotion of video conferencing and AARNet computer communications.

Late in 1991 the Australian Education Council's Working Party on a National Educational Communications Framework (AEC NECF) commissioned a number of consultancies relating to a "feasibility study for a national body to facilitate/coordinate national communications and related open learning techniques". The consultancies were "directed at assessing the contribution which communication technologies can make to education and training in general but specifically to education and training delivered according to the concept of open learning" (AEC, 1991). The six consultancies undertaken in that phase of the AEC Working Party activities and the consultants appointed were (DEET, 1992a):

1. Consultancy to assess the feasibility of establishing a small national collaborative education communications body (SA Tech, project manager John Mitchell).

2. Consultancy to assess the desirability of a national brokerage facility to service educational training providers of open learning (SA Tech, project manager Julie Carr).
3. Consultancy to identify opportunities for establishing common and agreed national technical specifications for telecommunications and computing equipment to be used in the delivery of open learning (Lane Communications Pty Ltd, project manager David Read).
4. Consultancy to identify improved educational outcomes that can be addressed by open learning delivery and to suggest processes to further these outcomes (Edith Cowan University, project manager Tony Knight).
5. Consultancy to evaluate broadcast TV as a delivery mechanism for education and training (Learning Network Ltd, project manager Ken Widdowson).
6. Consultancy to evaluate existing and potential use of learning centres to deliver open learning by a range of education/training providers (Open Learning Network, project manager Anne Gooley) (DEET, 1992a).

The terms of reference for the consultancies were comprehensive and there was much activity generated in educational technology circles. In the words of one participant:

> Over the last few months my unit [National Open Learning Policy Unit] and consultants employed by the AEC have been racing around the States and Territories to investigate the scope of developments in distance education and open learning and to determine the need for coordination of aspects of open learning delivery across educational sectors and regions (Bolton, 1992).

What are the outcomes from these activities? Reports, though submitted at the end of February 1992, have not been published. Some indications about the desired outcomes have been given by the Chair of the AEC Working Party (Spring, 1992), but there seems to be little publicly available evidence concerning the achievements of the consultancies. One tangible outcome appears to be the generation of good number of additional, related consultancies, projects, committees of review and requests for proposals. These include a consultancy to "investigate the establishment of a national clearing house/database on open learning and distance education" (DEET, 1992a), the Adult Literacy National Projects 1991/92 (DEET, 1992b), the NBEET review of alternative modes of delivery in higher education (NBEET, 1992a), the Open Learning Initiative (DEET, 1992c), submissions to a House of Representatives Standing Committee inquiry on the Sixth High Power TV Channel, and the NBEET project on the "effectiveness and potential of state of the art technologies in the delivery of higher education" (NBEET, 1992b).

So there has been considerable further activity, but it gives little direct evidence with which we might attempt to evaluate the outcomes of the initial round of consultancies. Yet the outcomes could be important for practitioners engaged in the day to day jobs of designing and delivering distance education and open learning. In the absence of published information, we have to do our own estimates, our own "what if" calculations, to guess what we are being led into with various aspects of the "National Educational Communications Framework". This paper attempts to do this in relation to Consultancy Number 3, "common and agreed national technical specifications for telecommunications and computing equipment to be used in the delivery of open learning", with particular reference to illustrative case studies from video conferencing and computer mediated communications.

What is meant by "common technical specifications"? How is the education sector to define and implement such specifications? What is the impact of the presence or absence of "common technical specifications" upon the work of educational technologists, instructional designers and curriculum developers in open learning and distance education?

Video conferencing

Video conferencing provides a good example of the problems the AEC Working Party may have had in mind when it sought advice on technical specifications for equipment. Of the very large number of specifications which may be used to describe the complex equipment for video conferencing, most may be defined adequately by some existing standard, for example by specifying PAL video for camera input and monitor output, and ISDN for switched network digital transmission. However, the way in which analogue video and audio input from cameras and microphones are digitalised, compressed and communicated between sites is not readily defined by accepted standards. Different vendors of the key item, the codec, adopt different specifications which constitute proprietary standards, or protocols. A useable international standard is not available, as explained below.

Thus we have the problem that at present the three types of video conferencing codecs installed at education sites in Australia, PictureTel, Rembrandt and GPT, are unable to communicate with other types of codecs. We cannot have connectivity between all ISDN video conferencing sites in the education sector except by all installing the same brand of codec. No doubt this is the main problem of specification contemplated by the AEC Working Party, in relation to this technology.

International standards for video conferencing and ISDN channel aggregation

The absence of useable international standards for connectivity ("interworking" or "inter-operability") between different vendor's codecs is due to two main problems.

Firstly, the present CCITT H261 set of standards for video conferencing (Richter, 1990; Fist, 1991) is incomplete. In particular, it lacks a standard for low bit rate audio. It uses 64 kb/s for audio, which leaves only 64 kb/s for video in the case of sites which use a "Microlink" or 2 x 64 kb/s for ISDN access. This is important because 2 x 64 kb/s is the most widely used basis for video conferencing (Atkinson, Latchem and Davy, 1991). The H261 set of protocols has not yet been used in Australia except at several industry sector sites with GPT's H261 codec. In the absence of demonstrations of H261 operating between different vendor's codecs over 2 x 64 kb/s, there are differing estimates about its useability at this level.

Secondly, the H261 set of standards does not provide for channel synchronisation in ISDN switched circuits ("B channel aggregation" or "n x 64 interface") (Quai, 1991). It is an essential function for applications which require more than one channel (more than 64 kb/s). In the absence of an international standard, two approaches are in use:

1 Codec vendors supply proprietary cards for synchronising 2 x 64 kb/s ISDN channels. This is an economical solution, built into the codec, but each site must

have the same codec. This solution is provided by both of the major vendors of codecs. It is mainly in use for PictureTel codecs.

2 The codec feeds synchronous data to a Summit Technologies' S2000 which undertakes the function of division of the outgoing bit stream into n x 64 kb/s and synchronisation of the incoming channels for passage to the codec for decoding. Each site must have an S2000. This solution is now in use, mainly for Rembrandt codecs.

Use of the Summit S2000 an expensive solution because the cost of the channel aggregation function increases sharply as the number of channels is increased. Synchronising up to six channels of user data, the basic cost per site for the S2000 is about $15,000 and it may be up to about $25,000, depending on whether it undertakes also the function of ISDN multiplexing. Rembrandt sites with S2000 channel synchronisation will require some minor additional work and expenditure, for a Rembrandt dual channel X21 interface, in order to communicate with sites which have a Rembrandt codec and Microlink access to ISDN without an S2000.

Clearly this situation is not in accord with the AEC Working Party's concept of "common technical specifications". The simplest and most desirable specification, conformance with a set of international standards promulgated by the most influential body in telecommunications, the CCITT (International Consultative Committee on Telegraphy and Telephony), will not be available for at least several years. Meanwhile, the education sector has equipped a substantial number of sites with codecs and gateways, as listed below. Nearly all of the sites in New South Wales are dual codec sites, listed twice.

i. PictureTel sites

On site codecs:

Deakin University (2 campuses, others being added)

Monash University (2 campuses) (with S2000s)

Curtin University (3 campuses)

Murdoch University (1 campus)

TAFE Western Australia (3 sites, expansion in progress)

University Centre, Sydney (joint UNE, CSU, Wollongong)

University of Wollongong (1 campus)

University of New England (4 campuses)

Charles Sturt University (3 campuses)

University of Central Queensland (4 campuses)

Sydney University Faculty of Veterinary Science (2 campuses)

PictureTel codec accessible at a Telecom TOC (Television Operating Centre):

A definite statement is not available at the time of writing, but Sydney

and Melbourne TOCs at least are likely to have both Rembrandt and

PictureTel codecs (obtained from OTC following its merger with Telecom).

These will be accessible also by ISDN, and will be available for "back to back" operation as protocol converters between sites with incompatible codecs.

Other gateways: all Western Australian PictureTel sites have ISDN access to a PictureTel codec at the Golden West Network's Bunbury WA uplink to an Optus A satellite transponder, which provides a television broadcasting outlet.

ii. Rembrandt sites

On site codecs (mostly with S2000 channel aggregation):

TAFE South Australia (8 colleges)
University of New England (4 campuses)
Charles Sturt University (3 campuses)
University Centre, Sydney (joint UNE, CSU, Wollongong)
Northern Territory University
Royal Melbourne Institute of Technology

Rembrandt codec accessible by fibre optic cable to a Telecom TOC (with S2000 channel aggregation):

Sydney: Uninet (Four universities: Sydney, Macquarie, UNSW, UTS)
Perth: Edith Cowan University

iii. GPT H120 sites

On site codecs (Megalinks, not ISDN)

University College of Northern Victoria — Bendigo, Mildura, Wangaratta, Shepparton and Swan Hill sites.

Other gateways: to a site with H120 codec and satellite uplink, in Melbourne.

Connectivity between sites

Prior to 1990 the approach to connectivity between ISDN video conferencing sites appeared to be a voluntary adherence to Rembrandt codecs and the Summit S2000 as defacto standards marketed by Telecom. However, this turned out to be unworkable. During 1990 and 1991 Deakin University and Monash purchased PictureTel codecs, followed by the decision in NSW late in 1991 to equip the University Centre in Sydney and Wollongong University with PictureTel, and place a PictureTel codec in each of the existing UNE and CSU sites. With Victoria and NSW seen as PictureTel states, Western Australia adopted PictureTel in December 1991, and in 1992 Queensland also became a PictureTel state. At present in the education sector, the PictureTel codec has taken over the role of defacto standard previously filled by Rembrandt's codec.

In 1991 the NDEC (National Distance Education Conference) Working Party on Educational Technology endorsed the following guidelines to promote interconnectivity and the future adoption of CCITT's H261 and associated standards (Atkinson, 1991):

Firstly, for sites which have not finalised a purchase or lease, it is suggested that a set of requests be put to the tenderers to elicit a "connectivity scale", and that scores on this simple scale be a criterion for selection of codecs:

1. Request the tenderers to demonstrate switched network connections to as many sites as they can.
2. Request the tenderers to enter into a contractual agreement to supply their implementation of H261 and associated standards by a specified date and specified price (with penalty clauses).
3. Request the tenderers to demonstrate their implementations of H261 and associated standards, between their own codecs, using one or both of 384 and 128 kb/s transmission.
4. Request the tenderers to provide independent testimony for passing of interoperability tests in other countries, and to demonstrate connectivity in Australia to at least one other vendor's codec, using at least one of:

a. 384 kb/s transmission (6 ISDN channels, synchronised by Summit's S2000);

b. 128 kb/s transmission (2 ISDN channels, with synchronisation functions performed by the codecs themselves without use of the S2000).

The requests listed above provide a simple ranking scheme for assessing the connectivity factor and pressuring the vendors to address the problem. Whilst connectivity is just one of a number of criteria which are relevant in the assessment of tenders, and the codec is only one component of a system, full consideration needs to be given to connectivity.

Secondly, it is suggested that sites which have finalised a purchase or lease be asked for a commitment to acquire H261 and associated standards as soon as these are available from the vendors, and a commitment to implementing connectivity to Microlink sites.

In this way the NDEC Working Party on Educational Technology recognised that a useable international standard would be unavailable for several years. NDEC could not endorse a particular one of the major proprietary protocols, and thus a common technical specification was unobtainable. Now, will it be possible for the AEC Working Party on the NECF to do any better than NDEC's Working Party? Probably not, although the AEC Working Party asked for consultant's advice on "equipment specifications which would be most suitable for becoming the national standard within each application" (AEC, 1991). A "national standard" brand of codec is neither definable nor amenable to implementation at present.

Significance of connectivity problems

To what extent does it matter, from the perspective of educational technologists, instructional designers and curriculum developers, that we do not have nation wide connectivity with ISDN video conferencing? Connectivity between all sites in the education sector is obviously a desirable objective. Access to a larger number of sites offers more opportunities for the developers of this medium to experiment with applications involving other campuses, for example in collaborative delivery of courses, conference presentations, professional continuing education, industry training, conducting specialised research groups, and communications for administration of multi campus institutions.

However, the importance of connectivity between all sites varies considerably from one organisation to another. For example, South Australian TAFE's video conferencing network has a capacity load from its communications for teaching and other internal work, and the importance of connectivity to others is relatively minor. By contrast, Murdoch University has only one campus, and therefore connectivity to other organisations' sites is a major concern, especially within Western Australia.

Whilst access to a larger number of sites does give more opportunities, it does not follow that access to every site in Australia is essential for effective use of this medium. In practice the limits to the number of sites accessed are more likely to be determined by the number of working relationships which can be established between institutions for teaching, research, administration or other purposes, compared with the limits due to incompatible equipment specifications. Since a codec can be used only for one session at any given time, sites which do have a large and diverse amount of work for video conferencing may overcome compatibility problems by installing a second type of codec.

Perspectives on the impact of the connectivity problem in relation to open learning and distance education depend also on perceptions about models for delivery. Video conferencing relates very well to regionalised approaches in which classes in study centres benefit from the strong element of real time, interactive tutorial support which this medium provides. Tutorials are important because many learners, especially the inexperienced, experience difficulty with the highly autonomous study required with open learning and distance education packages. Approaches centred on low cost national TV broadcasting, for example the Open Learning Initiative (DEET, 1992c), accord low importance to the tutorial function and thus are unlikely to generate significant use of video conferencing. The main uses for video conferencing in teaching and learning are likely to be in support of regionalised operations, for example within the boundaries of a State, and in that context, national connectivity is not essential.

Some commentators compare the problem in video conferencing with the problem of different railway gages in different states, which was held to be a serious barrier to transport of persons and freight between states. That would over emphasise the impact of the connectivity problem. The larger question which deserves the centre of attention is the extent to which we wish to "transport" education by a one way process from national centres, as in the Open Learning Initiative (DEET, 1992c), which eschews tutorial support. The alternative direction is regionalised "transport" of education by two way, interactive delivery which integrates tutorial support with open learning and distance education materials.

Computer communications

In contrast to video conferencing and its dependence on proprietary protocols, in computer communications we are now able to work with systems in which key functions are independent of proprietary protocols. Universal interconnectivity is approached, most notably illustrated in the case of AARNet, the Australian Academic and Research Network, which now connects all campuses of all Australian universities and a considerable number of Affiliate Members in other organisations.

AARNet has worldwide links through Internet, JANet, Bitnet and a variety of other networks.

Rather surprisingly, the AEC Working Party's list of objectives and issues for its Consultancy Number 3 did not mention computer communications, other than the real time form as used in audiographic teleconferencing (AEC, 1991). That was unfortunate, because an explicit direction to study AARNet could have helped the AEC Working Party towards a clearer, more productive understanding, not only in the area of technical specifications, but also more widely in relation to brokerage services (Consultancy 2), learning centres (Consultancy 6), database and clearing house functions (DEET, 1992a), and the "National Collaborative Educational Communications Authority" (NCECA) (Spring, 1992) or "Open Learning Technology Corporation" (Consultancy 1) (Bolton, 1992).

How would a study of AARNet and its "parent", Internet, help the AEC Working Party? As a private network created by the Australian Vice-Chancellors' Committee with strong support from the Commonwealth Scientific and Industrial Research Organisation (CSIRO), AARNet is unlikely to attract the attention of the AEC, a body dominated by State Ministers for Education and more closely linked to the school and TAFE sectors. Also, for the average person, computer communications are much more difficult to conceptualise and relate to open learning, compared with other media such as television broadcasting.

However, the AARNet phenomenon should have been a central topic for the AEC Working Party's consideration, for reasons which are broader than the direct use of computer communications as a support for open learning and distance education. Its importance is due also to some conceptual insights from computer communications protocols, architectures and organisation, which can help the AEC and other bodies towards a better understanding of the technologies and technologically mediated delivery of learning in general.

AARNet protocols and architectures

Broadly, network protocols allow one to specify or understand communication without knowing the details of a particular vendor's network hardware. Complex data communication systems use a set or family of cooperative protocols, each with a specified functional relationship to the others and generally describable by layered models (Comer, 1988). In this way AARNet undertakes a range of applications of computer communications which are independent of the types of physical link and end user hardware and software, provided that all are in conformity with the supported protocol sets. AARNet users may have in front of them Macintosh, DOS, Windows, Unix or other environments, and the transmission paths or network architecture they use may include one or more of Ethernet, ISDN, Megalinks, Digital Data Services, X25 packet switched, serial links, microwave links, satellite hops or others, even ordinary telephone lines. The end user does not need to know the details, which can be left to the specialists in network systems engineering.

The key set of protocols for AARNet is TCP/IP, named after one of its components, Transmission Control Protocol, and its more general family name, Internet Protocol (Comer, 1988; AARNet, 1992a). TCP/IP specifications are in the public domain, and though not an official international standard in the domain of CCITT, it is very widely supported by all the major vendors in computing and networking, by a varied range of gateways into other systems, and by a wide array of software in the public domain, especially for Unix, Macintosh and Microsoft's DOS and Windows. The concepts of independence from proprietary protocols and network hardware, and availability from a number of competing vendors are very significant reasons for the popularity of TCP/IP as a specification.

The basis from which TCP/IP originated is "internetworking", the linking of separate networks to one another to create networks of networks. The typical connection to AARNet is between an organisation's own network, for example a campus local area network (LAN), and a state or regional node, which is linked further to other regional or national nodes. Internetworking with TCP/IP means that the vast majority of the network resources reside with the individual networks and computer hosts owned and controlled by the members of AARNet, which is an important and convenient feature in relation to concerns about the autonomy and independence of institutions. Also, addition of TCP/IP to one's network does not disrupt other protocols which may be in use. For example, many users of Appletalk or other protocols which may be the basis for their LAN communications to printers and file servers are also users of TCP/IP for wide area communications.

If the AEC Working Party did look at the matter, TCP/IP provides for its purposes a ready made "common and agreed national technical specification" with very few problems about acceptability, ease of implementation and functionality on and between a wide range of types of local network.

However, AARNet is not a relevant basis at present for building audiographic teleconferencing systems, such as those using Apple based "Electronic Classroom" or DOS based "Telewriter". Typically, audiographic applications use their own proprietary protocols over public switched telephone network connections made as required for each teleconference session, in contrast to the permanent private network connections between local networks and hosts which are the basis for the TCP/IP protocol set.

AARNet organisation

AARNet is an excellent example of a "small national collaborative education communications body", having just two full time staff based in Canberra, and a simple annual subscription with no charges to members for connect time or traffic volume. AARNet's total expenditure program for 1992 is about $2.8 million, nearly all expended on the lease of communications bandwidth from AOTC (Australian and Overseas Telecommunications Corporation). AARNet's 1992 income is from the universities contributing about 40%, the Australian Research Council 36%, CSIRO 11%, and the Affiliate Membership program 13% (Huston, 1992). It could be said that the real costs of AARNet are underestimated if one does not includes costing for AARNet accessible services provided free to the rest of the world, such as OPACs (on line library catalogues), servers and files for anonymous file transfers. However, the principle of giving free resources, and obtaining free resources from the networks seems to be very effective and widely accepted.

AARNet provides its members with national and international access to e-mail, electronic publishing and news, file transfer, remote login or telnet capabilities, and some support services such as assignment of Internet addresses, a central domain name server and administration of the Affiliate member program. However, AARNet does not organise applications of these services or provide host computers. That is a matter for member institutions to undertake. In this respect commitment to AARNet has little impact on the individual autonomy and independence of organisations, which is fortunate when we consider how AARNet may relate to the education sectors which are the preserve of the State governments, the school and TAFE sectors.

As a network of networks, organisation of AARNet services such as electronic mail is quite different from older approaches which depended upon a single central host, for example Telecom's Keylink e–mail service, with which users interact directly over long distance connections. With AARNet, members organise their own services, that is their own LANs and associated host computers, which can be integrated with intra organisation needs, and much of the long distance communication is an automated host to host set of processes governed by the rules of TCP/IP. There are obvious economies and it is not surprising that the network of networks model is displacing the single central host model.

AARNet for open learning and distance education

AARNet provides an infrastructure which developers of open learning and distance education can use without having to design and implement their own network (Castro, 1990). However, there are some gaps in access to AARNet which are significant for open learning and distance education, particularly in relation to dialup connections by modem to an AARNet connected campus, and to the needs of rural and remote communities. The first of these concerns is being addressed by the ADEnet project (Atkinson and Castro, 1991), but the second is very dependent upon collaboration with the TAFE and school sectors.

Movement towards collaboration of TAFE with AARNet has commenced, using the organisational mechanism of Affiliate Membership. South Australian and Tasmanian TAFE have operational Affiliate Memberships. Western Australia will follow shortly, with their first year costs met by the DEET Communications Link Project, a Reserve Fund grant conducted by Murdoch University. The AARNet Advisory Board has considered the matter of TAFE connections and it

> endorsed a general model of interconnection to the TAFEs via connection of TAFE networks to AARNet at nominated gateway(s), and noted that such a model would not preclude a university and the State TAFE network reaching an individual agreement to share communications facilities to particular locations where there are common requirements (AARNet, 1992b).

In this way the AARNet Advisory Board has provided scope for smaller, remote locations to gain access to computer communications networks by sharing regional networking resources between sectors, as for example in the learning centre (McGregor and Latchem, 1991) or telecottage concepts (Horner and Reeve, 1991). Collaboration is important because the affordability of resources such as modems, leased data channels, quality printers and learning centres is improved by aggregating numbers of users across more than one sector in the smaller and remote locations. However, we do not know at this stage whether the AEC Working Party has recognised the opportunities for adoption of a simple, broad specification for organisation as well as for network protocols. This is that AARNet Affiliate Membership (AARNet, 1992a) be obtained for all TAFEs and eventually for all State Ministries of Education. Such a specification, which pertains more to organisational framework than to technical matters, would assist very considerably in the development of communications, in the broadest sense, for open learning and distance education.

Computer networking is not a delivery tool confined only to universities. Articles about Internet networking and its applications to K-12 education appear frequently on the networks. For example, Sears (1992) describes a TCP/IP network comprising 76 schools, 500 Macintoshes and PCs, a number of medium sized servers and a link to the University of California at Davis, serving nearly 50,000 staff and students with a variety of innovative applications.

AARNet provides open learning and distance education with an excellent infrastructure and the basic tools, which are email, electronic publishing and news, file transfer and remote login. However, developers of these services are needed for the vitally important role of implementing applications which are directly relevant to the needs of end users. For example, learning network centres (Consultancy No. 6, AEC, 1991) should be using AARNet based computer communications extensively, but the potential will not be obtained without reasonable investments in staff development and user services. Another example is the proposed national clearing house and database (DEET, 1992a), for which AARNet is the obvious networking mechanism, but the scope for implementing this function will not be realised unless there is encouragement for developers of services to implement modern tools such as WAIS and gopher servers.

As a network of networks and a vehicle for regional, national and international communications, AARNet carries services which are available to every user anytime and anywhere on the networks, and can be originated anytime from anywhere on the networks. Developers of open learning and distance education applications carried by AARNet do not have to worry about scheduling in the way that is the case with audio, audiographic and video conferencing or television broadcasting. Another important concept exemplified by AARNet is the scope for decentralised approaches in which a number of providers support a particular application. For example, the conduct of clearing house and database functions can be decentralised over the network by use of the gopher server concept, whilst the user interacts with gopher client software and sees a single database.

Perspectives on technical specifications

Video conferencing and computer communications via AARNet present contrasting cases with respect to the influence of "technical specifications". The first is dominated by proprietary protocols, resulting in a connectivity problem, whilst the second is independent of proprietary protocols and universal interconnectivity is approached. However, that does not mean that one is a success and the other is a failure. Suppose we view technical specifications as a problem within a broader set of problems, which may include problems arising from organisation and management for innovation, staff development, courseware development, curriculum issues, budgets to employ developers of new services, and the relative smallness of the research base. Which are the key problems? The research base, which is insufficient to give the required new insights into the hypothesis that "tutorials are important" and many other questions? Organisation and management for centralised or regionalised models? How do we assess whether to invest more resources in courseware development or more in tutorial and support measures? And so on.

From that perspective I suggest that the impact of the presence or absence of "common technical specifications" is relatively minor. Unfortunately, there can be a risk that the slightest faults, real or otherwise, in specifications and equipment performance with a particular technology may restrain the vision of our policy makers at the level of "what technology?". That would be disappointing. There are other and bigger questions, as in "what instructional design?", and "what curriculum development?" (McBeath and Atkinson, 1992), plus the "how" and "why" questions, and others.

It may be that in the AEC Working Party's agenda, "common technical specifications" is only a relatively minor side issue. If, for example, its real focus turns out to be upon organising national television broadcasting for a tutorless model of open learning and distance education, then technical specifications, development, research and other issues pertaining to interactive models for delivery will become marginalised. If "capacity to meet unmet demand" (Bolton, 1992) is the central or sole urgency for the AEC Working Party, then the two media discussed in this paper are unlikely to provide any short term help in the search for a panacea, although their medium and long term future is not in question. The AEC Working Party may envisage a role as a private networker leasing capacity from the carriers, AOTC and Optus, and reselling it in some way to individual organisations, which would require a large amount of work on technical specifications, plus many other aspects of private network systems. However, that is unlikely (one hopes so), because each State government is a player, or would be player, in private networking, and their attempts are in trouble (Clark, 1992).

Perhaps the AEC Working Party may have been better served by a clearer communication of its own goals and its view of the context for its work. Whilst it seems likely that the question of technical specifications was only a small part of its investigations, at least some observers have been given the impression that it represents a case of thinking that the right choice of technology with the right specifications will get it all right. The problem is that in most cases, selection of technology and technical specifications depends on a clear mandate to implement agreed goals in organisation, curriculum development and instructional design (McBeath and Atkinson, 1992). Technologies may stimulate thinking and planning for those prerequisites, but technologies by themselves cannot create and implement the preconditions for successful implementation.

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Considering the human factor in open learning: The police experience

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Increasing demands for a Police Force with a greater diversification of skills to cope with societal, environmental and technological change has led to the consideration of alternative methods of police training. Traditional on-campus teaching is no longer as viable as it used to be because competing time demands are resulting in fewer police officers being released for course attendance. To compensate for these problems, open learning has been considered as a viable, alternative method of training which can provide the flexibility necessary to balance the demands of policing and training.

Designing open learning, however, required careful attention to be given to the student learning processes given that many police are traditionally unskilled formal learners and have a negative view of learning and its related experiences. When the first police open learning program was designed at the Police Academy in 1991 many problems regarding learning relationships were encountered and had to be overcome. This paper provides an overview of the humanistic factors that were considered in the design of the open learning program and the impact these factors have for other organisations considering a similar venture.

History

Despite significant role changes for police in the past 50 years, society still tends to stereotype police officers as law enforcers. The complexity of modern policing, however, frequently encompasses the roles of welfare worker, marriage guidance counsellor, child minder, mediator, negotiator, first-aider, teacher and ambassador, in addition to law enforcement. The increasing variety of skills that police require to become functionally competent has presented police trainers with a dilemma: given the existing static resource situation, teach only critical survival skills or find alternative training methods.

The quest for alternative methods of training police officers has resulted in the consideration of open learning to provide flexible and individualised learning in the form of developmental modules. Individualisation of police education is critical given that required skill levels are largely driven by a police officer's current position objective, geographical location and contact with other cultures. With these problems in mind it was decided to design a pilot, text based, (distance) open learning program to provide greater flexibility in the police education process. The decision to design such a program was also based on the economic consideration that off campus students should make fewer demands on the capital resources of the Police Academy, such as classroom space, parking areas and human services.

The subject chosen for the pilot program was entitled 'Planning and Command, which basically covers the management of police emergency operations. This subject was selected for trial because, by necessity, it contains only material that is directly aligned with modern policing problems in Western Australia. Total, rather than partial relevancy was considered essential for initial open learning courses in a police environment because officers were more likely to demonstrate a greater commitment to this sort of subject material. It is, perhaps, more difficult to motivate police to learn subjects which they believe are more abstract in terms of their function such as human resource management, computer skills and corporate planning.

The design of the pilot open learning program required primary attention to be given to the development of students for participation in open learning and also consideration of student constructs which would affect their involvement. The development of actual teaching strategies and selection of teaching resources did not take place until after all student learning issues had been addressed. The purpose of this paper is to provide an outline of the considerations that should be given to the human element of open learning, that is, the needs and interaction of the students and teachers, rather than the development of actual teaching strategies and resources. It should be noted, however, that these elements are interwoven in the curriculum process and that the human element must, by necessity, be encompassed in all phases of instructional design.

Student Expectations and Attitudes to Learning

The notion of distance learning is not new to police officers in Western Australia. Promotional examination programs have been run by correspondence for many years. We must be careful, however, not to confuse distance education and open learning. While distance learning is often just another method of presenting standard on-campus courses, open learning requires unique instructional design capable of supporting the variety of choices that the learner should be permitted to make. Lewis (1988) states that in open learning the learning choices essentially lie with the students who decide how they will approach the learning, what they wish to learn, where the learning will occur and the methods they will employ in reaching their goals.

Traditionally the police student has been told by the organisation when to participate in promotional courses. This approach is based on an internal correspondence tuition system that provides information on when to enrol, when to sit for examinations and deadlines for submission of papers. The concept of open learning should reduce such bureaucracy and administration, providing students with individual choices (Daniel & Marquis, 1979; Wood, 1981). As with most open learning programs, the Police Academy program has neither set enrolment or completion dates nor are there any assignment deadlines. In addition, students may choose whether or not they require to undertake any formal assessment points that may be contained in the program. This was a concept totally alien to police students, who required familiarisation with the notion of 'freedom of choice' in learning.

Bagnall (1989) suggests that students should view their engagement in open learning as a role position which controls and directs the appropriate sequences of learning with the express intention of facilitating that learning. Educational goals for open learning should also include autonomy and self directedness (Botkin et al, 1979; Brookfield, 1985). The majority of police, however, have had little education beyond year 10 high school and consequently have had little experience with the concept of self direction in learning.

In addition, the didactic methods that have traditionally been applied at the Police Academy have resulted in police students aligning their police learning experiences with pedagogical learning experiences. "For many adults the subservient role of learner is incongruous with the other role positions they occupy" (Birkenbach, 1985, p.8). Police students, in general, have negative attitudes towards learning and educative experiences. Radloff (1990) concludes that negative learning experiences affect student motivation to become involved in new learning. In view of the experiences of police students, steps had to be taken to change attitudes to learning as part of the introduction of open learning programs.

To implement open learning for the first time it is essential to have a managed change process within the organisation. A change in the learning philosophy of police students was initiated simply by providing education about education itself. The structures and benefits of open learning systems were reinforced by police instructors at every contact opportunity. In addition, much attention was given to marketing the concept internally by using journals, newsletter and electronic mail facilities. Changes in learner philosophy have been gradual with those officers stationed in rural areas and having less Academy contact, taking longer to adopt new outlooks on training and accept the value of open learning as an appropriate learning experience. The inception of an Academy Outreach (country visitation) training program during late 1991, however, provided a better opportunity for Academy instructors to assist in the familiarisation of students with the benefits of open learning programs

Developing Independent Learners

Adults generally have more obstacles to contend with in their learning processes than children. Typically, obstacles such as competing role and time demands, fear of failure and concern about personal capabilities have a negative influence on learning (Knox, 1987; Birney et al, 1969). Policing is a profession which places extraordinary demands on an officer's time. Constantly rotating shifts, job related stress and the effect these factors have on family relationships influence the amount of time and effort that the police student can devote to learning. Consequently, the time that they do spend on study must result learning that has a significant depth of quality.

Assisting the police student to cope with learning and learning independence meant that student metacognition had to be considered at an early stage of the design process. Flavell (1976) refers to metacognition as being aware of one's own learning processes and exerting control over them. For students to be successful in open learning they must use metacognitive strategies to control the learning task and consequently have a more positive view of themselves as a learner (Bandura, 1982; Radloff, 1990).

Again, it was found that due to the general lack of involvement in 'formal learning' since leaving high school, most students needed assistance to develop their learning process. The instructional material for the pilot open learning course included some directions for the student on becoming a more effective learner. Students are directed to relevant, easy to read texts on strategies for successful learning and study. Other metacognitive strategies which are suggested to the student throughout the program include formulation of own questions about the material, reciprocal teaching (teaching another), talking out loud, focusing on key points and time management. Reciprocal teaching is suggested because its benefits are twofold. Firstly it enhances the student's learning and secondly it allows the dissemination of program information to other potential students in the police learning system.

It was important to consider effective learning skills throughout the entire instructional design phase and not merely to include such strategies as an afterthought. In the Police Academy pilot open learning program, metacognition is given attention throughout the lessons and assignments by providing access to resources which condense, summarise or paraphrase the main ideas and by providing self test questions that reinforce the material in the text.

Giving attention to actual learning processes in open learning design should create learners with better study skills, problem conceptualisation and lateral thinking as opposed to dependent learners who tend to have a narrower approach to learning and are less apt to go beyond the minimum demands of a challenge (Paul, 1990).

Teachers marking assignments from students after the program commenced reported that the students seemed to have developed a more positive outlook on learning. One of the more encouraging trends to arise from the provision of metacognitive strategies in the program was the willingness of police students to seek advice about involvement in other formal learning experiences. Many police officers are now more prepared to undertake learning commitments beyond the scope of the Police Academy in post secondary and tertiary institutions. Providing police students with basic learning skills has been the genesis for the re–discovery of self esteem through learning because of the positive experiences and successes that the student encounters.

The role of the teacher

Even in open learning systems there is a clear role for the teacher. Open learning is not independent of teachers because students rely heavily on teacher interaction, feedback, counselling and support, albeit in different ways from those used in traditional didactic methods. The teacher's role should include the provision of exercises and learning strategies that focus on the learning process, providing honest feedback, sensitivity to the students' external pressures and monitoring student's self concepts (Radloff, 1990; Warren–Langford, 1990).

In the Police Force, instructors are drawn from the rank and file and are usually officers who have considerable policing experience (at least 10 years). Their knowledge of educative processes, however, is often weak and they require some form of instructor or teacher development. In addition to trainer training strategies implemented by the Police Academy, those officers who are to be responsible for the open learning program required extra tuition, not only about their role but also about the whole concept of open learning. To facilitate the preparation of teachers for open learning, a teacher in–service workshop was designed specifically for open learning instruction. A critical objective of these workshops was to have teachers acknowledge the importance of developing positive relationships with their open learning students and to suggest strategies which will enhance this concept.

Students enrolling in the program are personally contacted by their assigned teacher at the commencement of studies within the program. Students are also encouraged to contact their teacher whenever they require guidance. Teachers monitor the progress of the students and will contact their students if a lack of response to the program is perceived. This should not be interpreted as an attempt to enforce deadlines but rather to ensure that students are 'on track'. Police Academy instructors are only too familiar with the job demands of the operational police officer and may often be in a position to provide some counselling for those students who may be experiencing personal or work related problems which affect their learning. Face to face contact is encouraged, where possible but the use of other media such as electronic mail, fax and telephones are also encouraged. The teacher's role in police open learning programs still needs to be a humanistic one as in the classroom. The teacher "can be a real person in his relationships with his students. He can be angry. He can also be sensitive and sympathetic...Thus he is a person to his students" (Rogers, 1967, p.59–60). It is the interpersonal development that occurs between students and teachers which, in effect, creates the setting for qualitative learning not always achievable by typical distance learning strategies which tend to base student–teacher interaction on the written rather than the spoken word.

Support networks

One factor that caused concern in the design of the open learning program was the informally reported rate of attrition in distance education conducted by the Police Academy and TAFE. Student personal factors have often been blamed for high attrition rates. To counteract these attrition rates it is important that institutions using open learning seek to provide student support and administration services (Paul, 1990; White & Watson, 1990).

With this in mind the Police Academy developed a number of support services for students, including:

- Providing system checks on student preparedness.
- Student counselling by teachers;
- Developing peer support networks;
- Fostering a sense of belonging;
- Program orientation.

The Police Force is, perhaps, more fortunate than many post secondary or tertiary institutions when it comes to the issue of fostering support networks. Students enrolled in the Planning and Command Open Learning Program are often able to get learning assistance from their peers and supervisors who have had actual field experience in the area of study. Student assistance comes from co–workers as well as allocated teachers. The flexibility of the program also allows officers, who are part of the peer support network, but not enrolled in the program, to access information from the teachers. Figure 1 shows the interaction model for the police open learning network which operates in conjunction with the Planning and Command Open Learning Program.

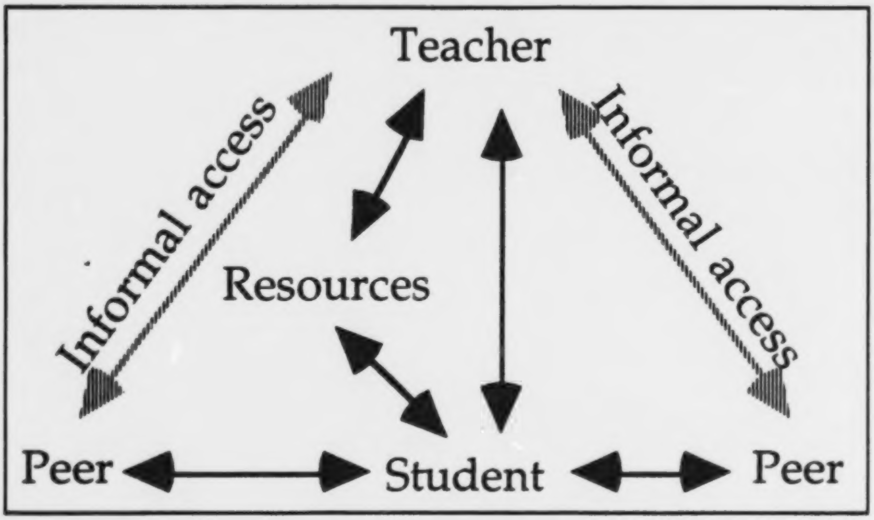

Figure 1: WA Police open learning interaction model.

One of the perceived benefits of on–campus education is the sense of belonging and the rapport that develops between students during courses. On–campus students inherit the right to participate in tutorials, use library material and access other resources. The Police Academy has taken steps to extend these rights to its open learning (off–campus) students. The delivery of lectures and tutorials by satellite and fibre optic technology is currently being trialed in an effort to extend the service offered to off–campus students. Library and educational resources have been made available to all student, statewide, at no individual cost. Although it is acknowledged that the social factors of on–campus education may never be transferred in their entirety to the distance open learning format, substantial efforts have been made at the Police Academy to increase the congruence between the two.

Summary

The development of open learning curricula must consider, above all, relationships. Relationships that exist between students and their learning processes, between students and the instructional material, between students and their teachers and between students and their peers. Open learning should not be a system without human contact. Though teaching strategies will vary from traditional didactic methods, the humanistic approach to open learning teaching is as important as in the classroom. The process of open learning should encompass, at every stage, a nurturing of these relationships and an ongoing commitment by teachers to student learning development.

> Open learning aims to provide flexible learning programs which meet the needs of adults in the workforce. This goal will only be achieved if program designers go beyond the content, the 'what' of learning and include a focus on the process, the 'how' of learning. The consequences of such a shift in thinking will be more independent, effective learners who can apply what they have learned to solve real life problems and who continue a lifelong process of learning. (Radloff, 1990, p.281).

Policing is a unique profession that demands multiskilling and continual development of officers in order to keep pace with rapidly changing societal, economic and technological trends. While open learning has the potential to expose police officers to a wider range of skills development, there can be little success without a fundamental change in personal philosophy about learning. It is my guess that the police experience with open learning is not unique to the Western Australia Police Force and the principles adopted for the development of the pilot open learning program can and should be applied by other organisations. Those who may consider developing open learning curricula for the first time would do well to remember that open learning, like traditional classroom teaching is a very human process. This view is supported by McBeath (1990) who states that open learning systems need to be written with the student firmly in mind.

> As institutions committed to lifelong learning we must do more than provide access and support. In every day, in every way, we must be passionate advocates of lifelong learning and do everything we can to help students develop the attitudes and skills which will maximise their opportunity for it. (Paul, 1990, p.37).

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Desk top publishing: A case study

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This paper describes the curriculum and design decision making behind the production of a new Study Guide and Workbook for internal and external students enrolled in Education 350 at Curtin University of Technology. Education 350 is a basic curriculum development unit studied by students enrolled in the TAFE and vocational teacher education program. The new Study Guide was to be a model of the sort of curriculum development that students at this level are required to produce for assessment, and needed to exemplify the curriculum concepts and principles contained in the unit. The paper describes the important issues behind the needs assessment, curriculum development, instructional design and technological decisions which helped to shape the new package. It also looks briefly at the importance of case studies in curriculum development and course evaluation.

I suppose the most surprising thing about the production of this Study Guide is that I didn't do it before. It was as though all the factors making it possible fell into place together. I had been teaching Ed350: Program development and evaluation for five years, with both on and off campus students, and it was time for a major revision. I had struggled with the Distance Education people for a number of those years to try to win more control over the course, but with little success. I had begun desk top publishing of a reasonable standard a couple of years ago, and had managed to substantially upgrade my office computer and printer by the beginning of last year.

A major problem had always been lack of time. Minor changes had been introduced each year, and my notes, resources and readings were beginning to hold together fairly well. I had a partial vision of what the package should look like, but as often happens with a busy program of teaching, research and publication, as well as all the other things one is expected to fit into an academic's life, I didn't know where I was going to find the concentrated time needed to do a thorough rewriting. Perhaps it would have been done eventually, squeezed in between other projects, late at night and on weekends. However, half way through last year development money became available from the Western Australian Distance Education Consortium (WADEC) for major revision of units and I applied for enough funding to buy me out of one class a week. That was sufficient.

Why I wanted to develop a Study Guide

In the Faculty of Education we put great store by flexible teaching methods and presentation techniques. As well as more formal techniques such as lecturing, seminar presentation and tutorials, we encourage class discussion, small group work, question answer exchanges and the sharing of experiences and insights to encourage experiential learning. The Faculty philosophy encourages a care giving role, whereby we are supposed to listen to student problems and deal with their concerns when they arise. This is supposed to provide role models for the students to take into their own teaching. However, in practice this sometimes means that the session dives off in its own spontaneous direction, and there is always the risk that the topics are not covered satisfactorily. We know that the students will rarely read further for themselves, apart from what is given as set reading. There is a text book, but it is meant to be used as supplementary and extension reading, to be read alongside the lecture topics and not as the subject matter of the unit. This situation worried me.

A couple of years ago a lecturer in the social sciences told me that she wrote every word of her lectures, in exactly the way she intended to present them. As an educationist, I was horrified, because it allowed for none of the flexibility and variety we considered so important. But her story stayed in the back of my mind. She had a complete record of every point covered. She knew without a doubt that she had said the things she meant to say, and had said them in the way she wanted them understood. Whether the students learned much, of course, is another matter, but she had found a way of solving what I thought was my main teaching problem, that of ensuring that the students had a record of everything they needed to know.

The external students also were missing out on some of the more important developmental issues. They had a textbook, a Plan, a Study Guide, an audio tape and the occasional teleconference. However, I realised from their assignments that, while they read more conscientiously than the on campus students, they were often missing a number of the linkages which should have held their field of study together.

To a certain extent my handouts were serving the on campus students reasonably well, as was the Study Guide for external students, but there were gaps and inconsistencies. The notes and materials needed to be brought together into a complete package with a unified structure and format with all the gaps filled.

The concept of an integral learning package is not new to distance educators, and a number of you might be wondering at my naivety, especially as I also have some background in external studies. But the concepts of distance education are not paid much more than lip service in the Faculty of Education, and I had given up asking for time to do the job properly. I was doing what I could, annoying the Distance Education people immensely by making small changes every year, gradually putting the bits in place, but never achieving what I really wanted in the rushed hours to meet those all important deadlines.

Then came the funding from WADEC, and all my frustrated energy cranked into gear. Two hours release time per week meant one less class to prepare for, a hundred or so less assignments to mark, less students to care for, counsel and worry about. I don't think senior people in the university system are aware of how much creative time is freed up by dropping one class per week. There was my time problem solved.

The time was right also from the point of view of the subject matter. Five years of teaching my subject at undergraduate and postgraduate level had filled in a lot of gaps in my knowledge and given me confidence and certainty of my perspective. I knew my subject well and knew what I wanted to include in the Study Guide.

Perhaps it would be more correct to say I knew where I wanted to start, a lot of things I wanted to write and some of the things I still had to research in more detail. I also thought I knew quite a bit about instructional design and desk top publishing, although I must admit in retrospect that I still had a large amount to learn.

The needs of the students

Ed350 is a basic curriculum development course for TAFE and adult vocational teacher trainees as part of their BA (TAFE Ed). The students are already practising teachers and are usually mature aged and experienced in their fields of competence, although not necessarily in teaching. They are usually highly motivated and more conscious of their own learning needs than the average undergraduate. They demand course material which is relevant, up to date, useful to their practice and at the right level for the award they are seeking.

The average age of the classes who study Ed350 each year is early to middle 30s. It is a requirement of entry that they should have had at least five years of industry or equivalent experience in the work force. The larger number of enrolments still come from TAFE colleges, where teachers are required to undertake teacher training before gaining permanency. Others come from hospitals, banks, the RAAF, the Police Academy and various Government Departments. They represent training fields as diverse as bricklaying, electronics, child care studies, local government, hairdressing and horticulture. Many have attained university entry through the Alternative Test for Adult Admission, although a number have matriculated in the normal way.

Ed350 is studied in the final year of their BA (TAFE Ed), when their self esteem and confidence level is usually well established and they are beginning to see themselves as professional educators and to believe in the possibility of graduation by the end of the year. They have usually established good study habits by this stage and, with very few exceptions, tend to over achieve in the quality and thoroughness of their assignments. They are a pleasure to teach, but they suffer no nonsense. They recognise poor quality teaching and sloppy preparation and complain about it if it occurs.

In spite of their being well motivated adults, however, they are still undergraduates, preparing for a practical profession. They insist on knowing why they have to study a unit, where it fits in with their professional development and career prospects and whether it will have long term relevance. They still expect to be told what to learn and they wont necessarily do any extra reading or research, unless it is in some way beneficial for their teaching, their assignments, or their grades. If a lecturer misses something important, most of them will not go and catch up on it by themselves. Class discussion of an issue is not necessarily enough for them to grasp a new concept; they often digress in the most amazing ways. They still need direction. They still need readings or handouts or something concrete to study and revise to consolidate the work covered in lectures and tutorials.

Case studies on instructional design are not often concerned with content or curriculum issues. However in this case I was subject specialist as well as designer. The selection and structure of the content played an important role in the package design. I begin therefore with some comments on curriculum matters.

Content: the curriculum issues

The unit was named Program development and evaluation, and the TAFE and industry representatives on the Program Advisory committee probably saw its purpose in fairly simplistic and practical terms. I believed, however, that the content had to be integral to the field of curriculum studies. It needed to rest on the research and literature, theory and practice of curriculum development. If this did not occur, then the place of the unit as part of a degree level course might be hard to justify.

The unit needed the right amount of emphasis on the fashionable concepts of the day, such as competency based training, modularised and self paced learning, and it needed to be set against the background of industry restructuring. It needed to be cognisant of the demands of the National Training Board, the new state based Employment and Skills Development Authority, Skills Standards Accreditation Board, the Industry Employment and Training Councils and the training directives emanating from the Federal Government and its various committees. It needed to introduce the students to alternative delivery systems and the new technologies advocated by TAFE, DEET and VEETAC as the way of the future. However, it needed also to contain a solid grounding in the literature, and a wide and balanced overview of the findings of curriculum research and the development of key concepts in the curriculum field.

The most significant characteristic of mainstream curriculum research literature is that most of it has come from the schools sector, and the greater part from the USA. My own post graduate work in the field had been done in Britain, and my perspective on curriculum theory and practice had been influenced by the paradigm shift of the 1970s. Much of the thinking of TAFE and industry training is still rooted in the earlier Tylerian paradigm, (Tyler, 1949), with an overlay of more recent management psychology, although their needs usually are much broader than they believe.

It is not easy to take a field of research based in one sector and transport it realistically and meaningfully to another. If it has not been done before in any substantial way, as is the case in Australia, it can take many years of refocus and reinterpretation, and certainly could not have been done in the four months available to develop the Study Guide. I was lucky in that I had spent over a decade trying to do just that, both as a curriculum developer and researcher in the TAFE sector and then as lecturer and unit coordinator in the Curtin trainer training program. I also had a good collection of anecdotes and examples to emphasise my points.

Contact was made with my counterparts in other states to see what they were doing and to share some of my ideas with them. It is generous in these days of entrepreneurism and accountability in the tertiary sector for a developer to show his or her work to a potential rival provider in another state. I had heard warnings about people stealing your unit and then taking your students, etc. I must therefore specifically acknowledge and thank Clive Chappell at the University of Technology, Sydney, for forwarding a draft of the unit he was developing for a similar class. In return I sent him some early draft material and later the completed first edition. Similarly a copy was sent to a colleague who was doing some development of a slightly different kind at the University of South Queensland, and he gave me some excellent feed back on my section on evaluation, which was his specialism. I don't believe people normally steal your work and use it themselves. I think they probably read it with interest, check where it coincides and where it departs from their own work and then set out to produce something better. Sharing work in the long run must improve the quality of the teaching learning approach of all the parties involved. It also makes others aware of your work and your strengths and with any luck they will quote you in their next Study Guide. I used something from Chappell's package, and although I modified it slightly, I acknowledged it properly and his name went into my reference list along with Ralph Tyler, Lawrence Stenhouse, Michael Fullan and all the rest. Possibly he will do the same with some of my work.

This brings me to another very important point. Writing the content for a learning package carries the same responsibilities as writing an academic paper for publication. The references must be correct and complete and the writer's own work clearly distinguished from that of others. Diagrams and models from the literature should be referenced and those derived or re-drawn must be appropriately acknowledged. Too often this nicety is overlooked in course or unit notes prepared for tertiary students and I feel very strongly about it. The students themselves are warned against plagiarism and everything we give them should be a model for them to emulate.

The content was carefully planned, along with the structure of the topics, the timetable, the assignments and the weekly reading. The content itself contained advice on how to design and develop curriculum materials and care had to be taken to adhere to my own message. I was aware of the early work on sequence, continuity and integration of content, and the admonition that content should be psychologically rather than logically structured (Tyler, 1949; Mager & Beach, 1967; etc). There was to be a second unit in Program development and evaluation in the second semester, and certain topics needed to be left for more complex development, even though they might have fitted logically into the first unit. I predicated their later inclusion, so that the students would know the topics were coming up later, and why (Figure 1).

> Note the topics which will be covered in the next curriculum unit, Ed367: *Program development and evaluation* 2. This will be available in the second part of your course.
>
> 1. Curriculum context and policy
> 2. Curriculum dissemination and diffusion
> 3. Curriculum implementation
> 4. Occupational analysis
> 5. Techniques of occupational data gathering
> 6. Examples of occupational analysis
> 7. Doing an occupational analysis
>
> The second unit will deal with the constraints of curriculum development and you will have the opportunity to do an occupational or needs analysis on a topic in your teaching area.

Figure 1. Topics planned for second Study Guide

Another principle was that curriculum material should be valid, significant, useful and at the right level for student needs. For this to happen, it had to be up to date and backed by official documentation from government and industry. The latest versions of curriculum policy from the TAFE Authority were acquired and I wrote to other states for national exemplars of curriculum development. Simultaneously the package had to reflect the changing concerns from the field of curriculum theory, such as dissemination and implementation issues and new delivery systems. I wanted to give the students some sense of the history and the changing problems of the field, but without overloading the unit. Models and definitions from as far back as Tyler (1949) were included, as well as mainstream writers from the 70s, 80s and 90s. However the main thrust was practical, with more on how things are done than on curriculum theory (Figure 2).

Format: the instructional design issues

Some instructional designers like to discuss establishing learning objectives early in the design stage. Objectives, however, are at issue in the curriculum literature. The objectives debate is a feature of the post Tylerian curriculum paradigm. Some argue strongly against tying down a learning program to a finite set of learning objectives or competencies, when we know that its wealth as a learning experience may lie far beyond anything we could define as learning outcomes. However, our students are taught to set objectives, and have from time to time questioned whether we would be prepared to define our courses in competency terms in the same way as they are expected to do. In fact most of our units do define terminal objectives of a fairly generic nature, although many of us are not prepared to tie our teaching too narrowly to specific learning objectives, believing that the outcomes ultimately come down to how much a student wants to achieve from a course of study. Most of our mature aged students tend to over achieve, and we rather like it that way. Setting specific objectives for tertiary study, it is widely believed, may have the effect of stifling motivation for over achievement and defining success at the level of the lowest common denominator. (Eisner, 1966; Stenhouse, 1976; etc.)

At the beginning of this project I decided to retain generic terminal objectives as part of the Unit Plan but not include further objectives in the Study Guide. I am not sure why I eventually changed my mind. I had spoken about my project to an instructional designer in Distance Education, who had told me to go ahead with or without objectives as I felt best. Clive Chappell had included outcome objectives in his Study Guide at UTS, and the issue had been discussed recently with the class, debating whether it was worth the effort to write objectives for a unit like this or whether it was best to let the material lead each student to achieve as well as he or she could, or as well as he or she chose, within a broad spectrum of possible outcomes.

Much of what the students needed to learn would not be tested as part of the unit, but would be taken up in their professional awareness for use at a later time, or could be referred to again if and when they became involved in curriculum work. In brief, I was not prepared to test the achievement of learning outcomes for each segment of the unit, but wanted the students rather to reach a level of knowledge and creativity within the field to cope imaginatively and in an informed way with their assignments, and with later professional activities.

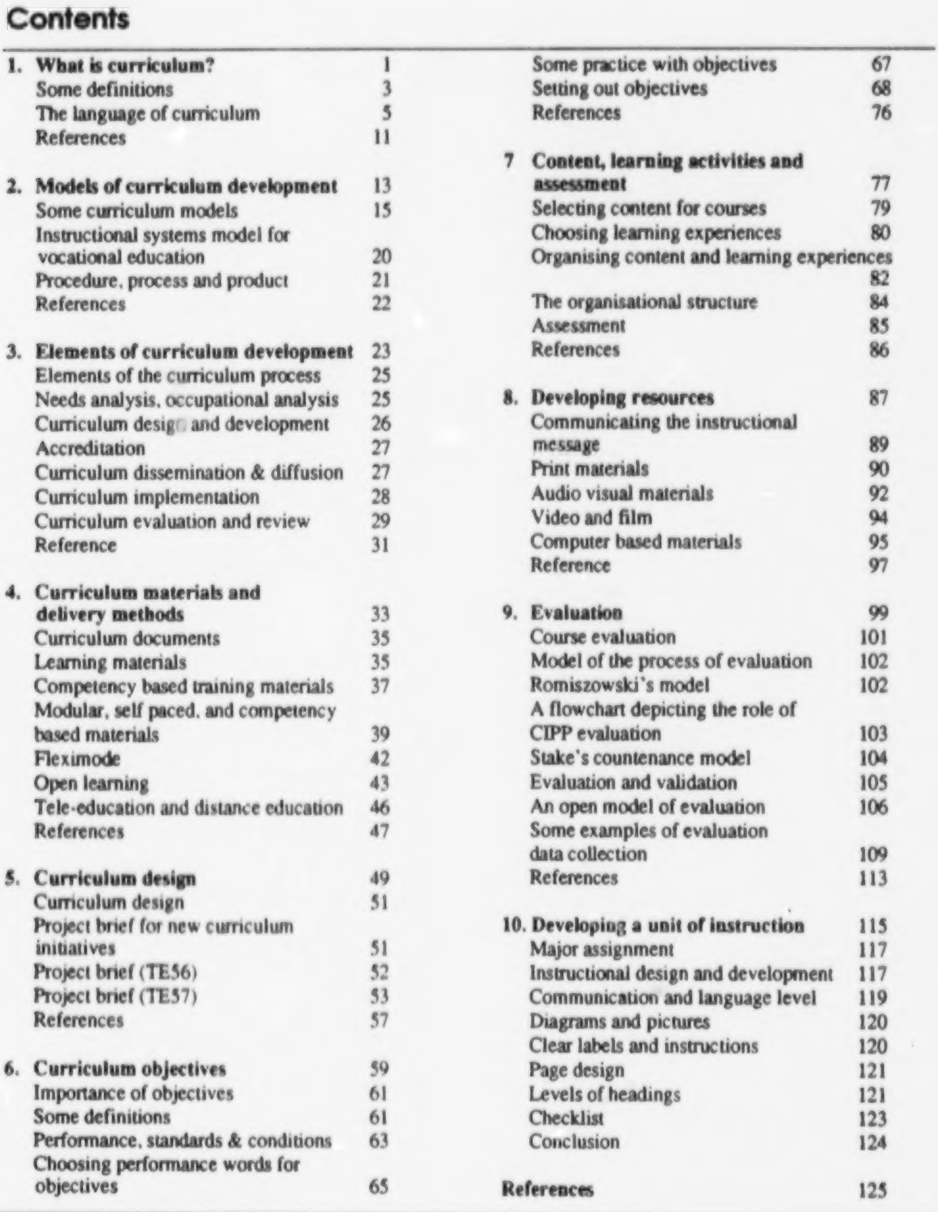

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Figure 2: Table of contents

Eventually I reached a compromise. I set personal learning goals for each section of the Study Guide, and suggested in the introduction that they check for themselves whether they had achieved them to their own satisfaction. The objectives were based on the subtopics in each section and involved processing them at different levels of Bloom's taxonomy (1956), such as identifying, recognising, describing, categorising, interpreting, analysing, generalising to their own situation, discussing in relation to their own teaching area, demonstrating an appreciation of the importance in curriculum planning, synthesising earlier knowledge into the broader context of curriculum planning, demonstrating comprehension and appreciation of and applying in their assignments, demonstrating an appreciation of curriculum choice, demonstrating their assimilation through appropriate choice and application (Figure 3).

1 At the end of this section you should be able to distinguish and identify
  1) curriculum definitions as given in the text
  2) the language of curriculum

2 At the end of this section you should be able to identify, interpret and analyse in reference to curriculum development in your own teaching area
  1) curriculum models as given in the text
  2) instructional systems model for vocational education
  3) procedure, process and product

3 At the end of this section you should be able to recognise and categorise the following and generalise to your own situation
  1) elements of the curriculum process
  2) needs analysis, occupational analysis
  3) curriculum design and development
  4) accreditation
  5) curriculum dissemination and diffusion
  6) curriculum implementation
  7) curriculum evaluation and review

4 At the end of this section you should be able to identify, describe and discuss in relation to your own teaching area
  1) curriculum documents
  2) learning materials
  3) competency based training materials
  4) modular, self paced, competency based materials
  5) fleximode
  6) open learning
  7) tele-education and distance education

5 At the end of this section you should be able to demonstrate an appreciation of the importance of design in curriculum planning, with particular reference to
  1) curriculum design
  2) project brief for new curriculum initiatives
  3) project brief (TE56)
  4) project brief (TE57)

6 At the end of this section you should be able to synthesis earlier knowledge of objectives into the broader context of curriculum planning and apply the following into to your final assignment
  1) the importance of objectives
  2) goals, aims and objectives
  3) performance, standards and conditions
  4) choosing performance words for objectives
  5) some practice with objectives
  6) setting out objectives

7 At the end of this section you should be able to demonstrate comprehension and appreciation of the following and apply them in your final assignment
   1) selecting content for courses
   2) choosing learning experiences
   3) organising content and learning experiences
   4) the organisational structure
   5) assessment

8 At the end of this section you should be able to identify, describe and demonstrate an appreciation of curriculum choice in relation to the following
   1) communicating the instructional message
   2) print materials
   3) audio visual materials
   4) video and film
   5) computer based materials

9 At the end of this section you should be able to describe and apply the principles related to the following
   1) course evaluation
   2) model of the process of evaluation
   3) Romiszowski's model
   4) a flowchart depicting the role of CIPP evaluation
   5) Stake's countenance model
   6) evaluation and validation
   7) an open model of evaluation
   8) some examples of evaluation

10 At the end of this section you should be able to demonstrate your assimilation of the following through appropriate choice and application in your final assignment
   1) major assignment
   2) instructional design and development
   3) communication and language level
   4) diagrams and pictures
   5) clear labels and instructions
   6) page design
   7) levels of headings
   8) checklist

Figure 3. Personal learning objectives

A second issue concerned the exercises, self testers, revision questions, recycling exercises and simulation games, the learning activities which distinguish a workbook from a text book. These are the ingredients which can make a Study Guide fun, but they can also be frustrating. One external student suggested that I should have put all the "correct" answers at the end of the book, so that students could check whether they were on the right track. As many of these exercises are included specifically as extenders, to stretch the students' imagination outside the given material, or to encourage them to make connections with concepts in other units or in their workplaces, it would have been self defeating to have included answers. However, it is not difficult to understand the feelings of frustration of a student working in isolation. Many of the exercises have no "correct" answer and are best suited for group discussion or small group work. My use of them as small group discussion topics for on campus classes indicated that different people cope with them in different ways, according to their varying perspectives and experiences.

The activities were divided into two kinds, "think" and "write" and labelled with two different symbols. The "write" questions tended to be the easier, in that answers could often be found in the text, or extrapolated from the text material. The "think" exercises were less likely to have real answers, but could be used to promote discussion or simulation. I found it useful to give a few "write" exercises first, to encourage a sense of success, followed by some "think" questions (Figure 4).

A series of "write" questions were used early in the Study Guide as a kind of attitudinal pretest. At the end of the semester, I returned to these questions with the on campus students and asked them whether they had changed their minds about their initial answers. Such an exercise can demonstrate the amount of knowledge and confidence they have gained, sometimes without their noticing it (Figure 5).

Some simulation exercises were included, whereby students were required to imagine they had a certain job to perform and were asked to role-play using the concepts given in the text (Figure 6). I doubt whether the external students would have made much of these exercises, and the on campus students usually ran out of time before the exercises could be completed. However I justified including them on the grounds of awareness raising and perhaps sowing seeds of thought which may bear fruit in the future. They could also be used as assignment questions with another class at another time.

What is an objective?..

What are the three parts of a well written learning objective?..

What kind of an objective deals with knowledge?..

What kind of an objective deals with practical skills?..

What kind of an objective deals with values and attitudes?..

What is a terminal objective?..

Look at the objectives in the subject syllabuses you use in your area of teaching.

Do they include standards and conditions?

What are the advantages of including standards and conditions as part of the objectives? What difficulties could arise if they are not included?

How do WA TAFE syllabuses attempt to overcome the problems inherent in not using standards and conditions as part of their objectives statements?

(Section 6)

Figure 4. Some examples of "write" and "think" exercises

What do you think of when you hear the word

curriculum?..

....

....

What products do you think

of?...

....

.....

What

processes?..

....

....

What do you expect to learn from this

unit?...

....

....

(Section 1)

Figure 5: An attitudinal pretest

You want to teach your students to change a car tyre. You need to plan and develop a mini lesson to ensure that they learn what you want to teach.
Write a suitable competency statement for the lesson.
Now write a terminal objective, including the performance, standard and condition you expect.
List the tasks or steps by which the students will reach the desired performance.
Write these skills as enabling objectives.
How would you test the students on their performance?
How would you grade them? (Section 6)

Imagine you were in charge of a large scale evaluation in your area of study in a non metropolitan region. What sort of profile would you have to develop at the planning stage? What sort of questions would you need to look into?

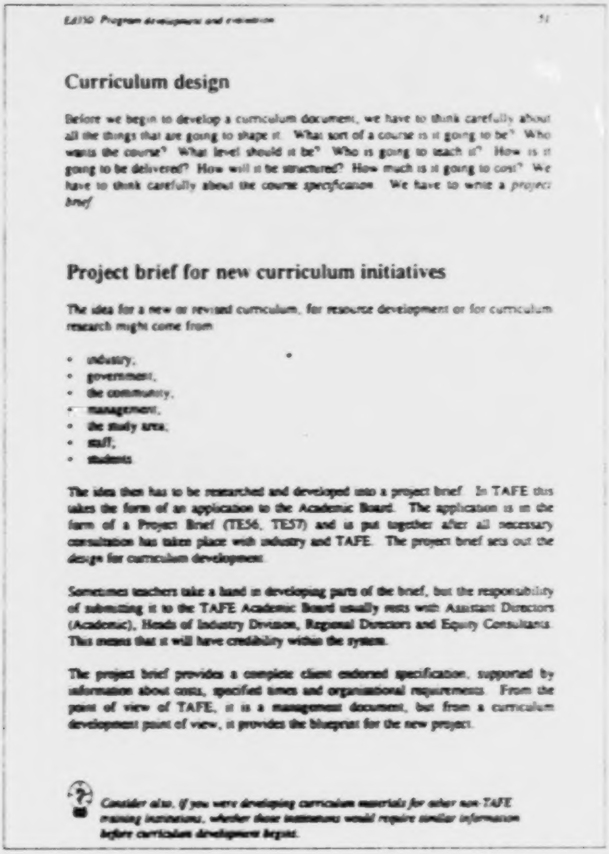
How differently might you go about evaluating an access program in a rural area, for instance, and a mainstream trade course in a metropolitan college?

(Section 9)

Figure 6. Some simulation exercises

The choice of exercises and questions and the decision to include them at certain points in the text was not particularly scientific, even though this issue has been dealt with in the instructional design literature (Mitchell, 1987; Ziegfeld & Tarp, 1989; Parker, 1990: WADEC, 1992.). The aim was for optimal variety of activity and visual impact, something like a child's reader, and I was happy to include too many activities rather than too few (Rowntree, 1974).

Sometimes the questions followed automatically from a block of new material, in the sense that it was time to stop and think about a new idea before moving on with the next. At times when the text was becoming too long and appeared too dense on the page, it needed breaking up with some kind of activity, in the same way as a classroom teacher might stop and ask a question when the class seemed to be losing concentration. At others, questions and exercises were added for no better reason than an impression that something was needed to fill an empty space on a page.



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Curriculum design

Before we begin to develop a curriculum document, we have to think carefully about all the things that are going to shape it. What sort of a course is it going to be? Who wants the course? What level should it be? Who is going to teach it? How is it going to be delivered? How will it be structured? How much is it going to cost? We have to think carefully about the course specification. We have to write a *project brief*.

Project brief for new curriculum initiatives

The idea for a new or revised curriculum, for resource development or for curriculum research might come from

- industry,
- government,
- the community,
- management,
- the study area,
- staff;
- students.

The idea then has to be researched and developed into a project brief. In TAFE this takes the form of an application to the Academic Board. The application is in the form of a Project Brief (TE56, TE57) and is put together after all necessary consultation has taken place with industry and TAFE. The project brief sets out the design for curriculum development.

Sometimes teachers take a hand in developing parts of the brief, but the responsibility of submitting it to the TAFE Academic Board usually rests with Assistant Directors (Academic), Heads of Industry Division, Regional Directors and Equity Consultants. This means that it will have credibility within the system.

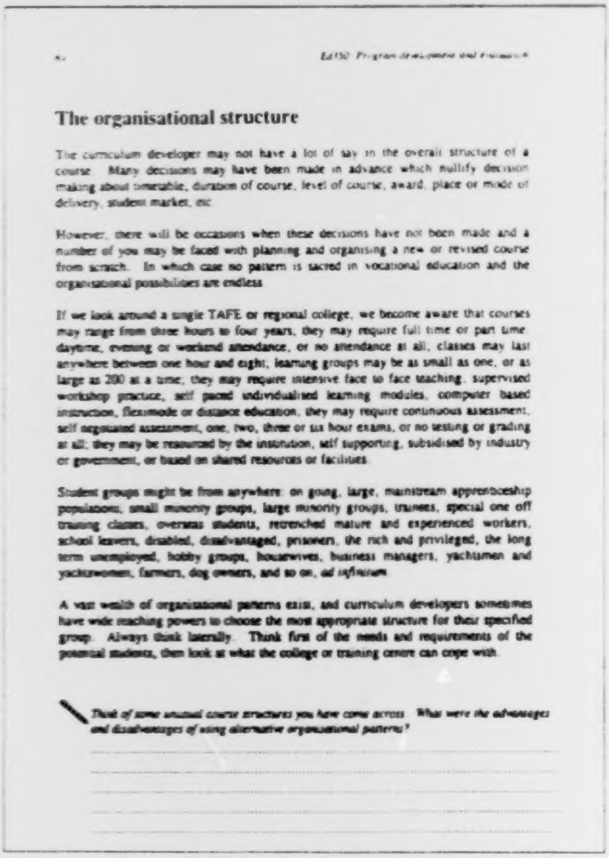
The project brief provides a complete client endorsed specification, supported by information about costs, specified times and organisational requirements. From the point of view of TAFE, it is a management document, but from a curriculum development point of view, it provides the blueprint for the new project.

Consider also, if you were developing curriculum materials for other non-TAFE training institutions, whether those institutions would require similar information before curriculum development begins.

Figure 7. Page design 1

The third and final instructional design issue I want to discuss is that of page design. Decisions have to be made regarding the size of text, number and size of headings, line length, headers, spacing, indenting, density of text, use of boxes, graphics, symbols and other forms of decoration (Priestly, 1991). Once these decisions have been made, they should be recorded and adhered to consistently. Yet it surprised me how often I changed my mind and altered the basic settings.

One of the first significant decisions made was to enlarge the text size to 12 pt and major headings to 18. This was larger than I had been working with, but it proved a comfortable size to read on the computer screen and it looked good on the print out. It was then fairly easy to settle on 14 pt subheadings, although I found I needed to be careful about spacing before and after the subheadings, which could make a page look unbalanced if not treated carefully. Another early decision I made, and did not change, was the font. There was only one font worth using on my Word for Windows package and that was CG Times. It seemed to work satisfactorily for continuous text, headings, bold and italics. I didn't know as much about fonts as I do now, but I would make the same decision again with the same range of tools to choose from.



The organisational structure

The curriculum developer may not have a lot of say in the overall structure of a course. Many decisions may have been made in advance which nullify decision making about timetable, duration of course, level of course, award, place or mode of delivery, student market, etc.

However, there will be occasions when these decisions have not been made and a number of you may be faced with planning and organising a new or revised course from scratch. In which case no pattern is sacred in vocational education and the organisational possibilities are endless.

If we look around a single TAFE or regional college, we become aware that courses may range from three hours to four years; they may require full time or part time daytime, evening or weekend attendance, or no attendance at all; classes may last anywhere between one hour and eight; learning groups may be as small as one, or as large as 200 at a time; they may require intensive face to face teaching, supervised workshop practice, self paced individualised learning modules, computer based instruction, flexímode or distance education; they may require continuous assessment, self negotiated assessment, one, two, three or six hour exams, or no testing or grading at all; they may be resourced by the institution, self supporting, subsidised by industry or government, or based on shared resources or facilities.

Student groups might be from anywhere: on going, large, mainstream apprenticeship populations, small minority groups, large minority groups, trainees, special one off training classes, overseas students, retrenched mature and experienced workers, school leavers, disabled, disadvantaged, prisoners, the rich and privileged, the long term unemployed, hobby groups, housewives, business managers, yachtsmen and yachtswomen, farmers, dog owners, and so on, *ad infinitum*.

A vast wealth of organisational patterns exist, and curriculum developers sometimes have wide reaching powers to choose the most appropriate structure for their specified group. Always think laterally. Think first of the needs and requirements of the potential students, then look at what the college or training centre can cope with.

Think of some unusual course structures you have come across. What were the advantages and disadvantages of using alternative organisational patterns?

Figure 8. Page design 2

The Study Guide was to be produced on A4 pages and margin width was another early decision, but one made on personal preference for line length judged by the naked eye, rather than actually knowing what I was doing with the computer settings. I had changed my mind again by the time I started the Study Guide for the second semester, and reduced the line length slightly, to accommodate a 3 cm margin all round. These margins have now become my default settings.

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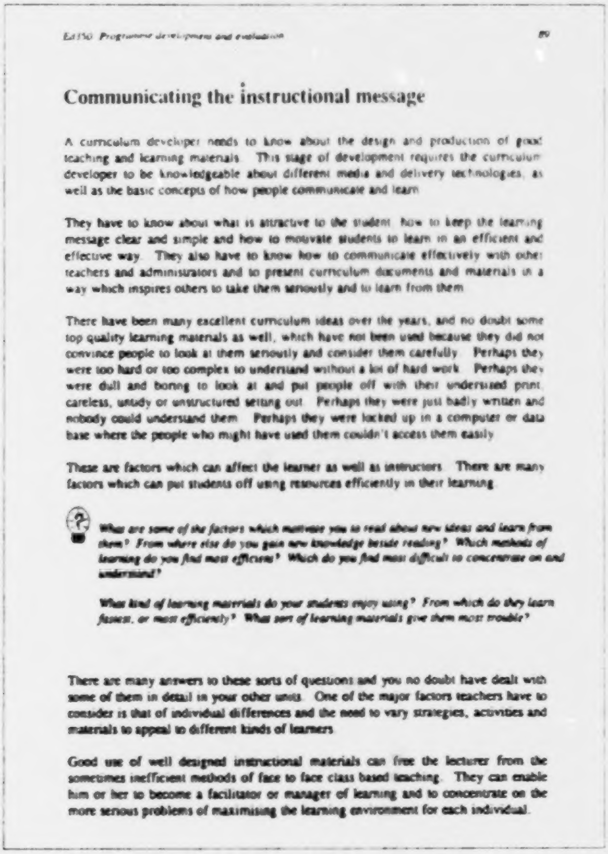
I overdid the boxes and the bolding in my early efforts. I wanted to distinguish clearly between text, quotations and exercises, and spent a lot of effort experimenting with different sized indents, styles and borders. I was well into the package before I settled on the exercises in 11 pt italics, the quotations indented 1.25 cms on each margin, and the use of boxes only for very special emphasis. The Keep it Simple principle helped with some of these decisions and I wasn't unduly tempted to decorate every page with every pretty thing I could find on my computer.

Another principle developed as I progressed was that every page needed a certain amount of individual crafting. A page should start and stop in a logical place if possible and spaces between the lines might need squeezing or expanding to conceal awkward page breaks. Lists of phrases or sentences frequently need adjusting to avoid them spilling over onto the next page.



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Communicating the instructional message

A curriculum developer needs to know about the design and production of good teaching and learning materials. This stage of development requires the curriculum developer to be knowledgeable about different media and delivery technologies, as well as the basic concepts of how people communicate and learn.

They have to know about what is attractive to the student, how to keep the learning message clear and simple and how to motivate students to learn in an efficient and effective way. They also have to know how to communicate effectively with other teachers and administrators and to present curriculum documents and materials in a way which inspires others to take them seriously and to learn from them.

There have been many excellent curriculum ideas over the years, and no doubt some top quality learning materials as well, which have not been used because they did not convince people to look at them seriously and consider them carefully. Perhaps they were too hard or too complex to understand without a lot of hard work. Perhaps they were dull and boring to look at and put people off with their understated print, careless, untidy or unstructured setting out. Perhaps they were just badly written and nobody could understand them. Perhaps they were locked up in a computer or data base where the people who might have used them couldn't access them easily.

These are factors which can affect the learner as well as instructors. There are many factors which can put students off using resources efficiently in their learning.

What are some of the factors which motivate you to read about new ideas and learn from them? From where else do you gain new knowledge beside reading? Which methods of learning do you find most efficient? Which do you find most difficult to concentrate on and understand?

What kind of learning materials do your students enjoy using? From which do they learn fastest, or most efficiently? What sort of learning materials give them most trouble?

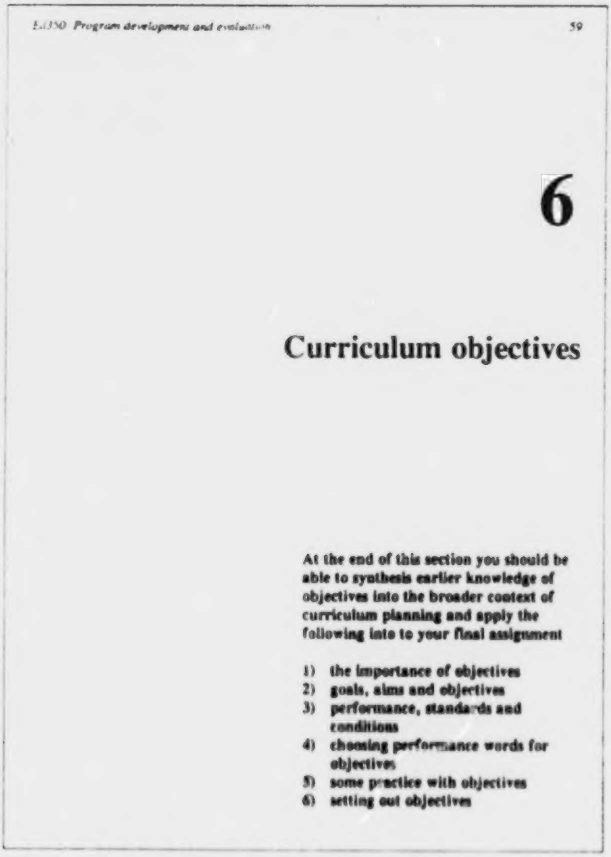
There are many answers to these sorts of questions and you no doubt have dealt with some of them in detail in your other units. One of the major factors teachers have to consider is that of individual differences and the need to vary strategies, activities and materials to appeal to different kinds of learners.

Good use of well designed instructional materials can free the lecturer from the sometimes inefficient methods of face to face class based teaching. They can enable him or her to become a facilitator or manager of learning and to concentrate on the more serious problems of maximising the learning environment for each individual.

Figure 9. Page design 3

In the same way as the package design aimed for a variety of activities, in the hope that frequent changes of pace would help retain students interest, so also it aimed for visual variety on each page. The exercises and questions helped do this, as did the headings and subheadings, but some pages needed a number of changes before I felt they achieved this aim. As a general rule, the text is broken on every page with a heading, a quotation or series of quotations, a diagram or table, or with the exercises and activities referred to above. Each page was supposed to look interesting, with plenty of change and plenty of space (Figs 7, 8 and 9).

The title pages for each of the ten sections probably took the longest time to fall into place. At first they consisted of the section number and heading, one third down the page, right justified, 24 pts and bolded. Eventually I added the objectives, then enlarged and lifted the section number. The section pages are now better than they were, but possibly still too plain (Figure 10). Further development of the design of section pages may occur as I become more confident with the functions on my computer, but for the first effort I kept strictly to the simplicity principle.



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Curriculum objectives

At the end of this section you should be able to synthesis earlier knowledge of objectives into the broader context of curriculum planning and apply the following into to your final assignment

1) the importance of objectives
2) goals, aims and objectives
3) performance, standards and conditions
4) choosing performance words for objectives
5) some practice with objectives
6) setting out objectives

Figure 10. Section title page design

Desk top publishing: the technological issues

I had had some experience of desk top publishing, working on a well equipped Macintosh system at another place and having someone else to do the diagrams and art work (Atkinson and McBeath, 1990; Atkinson, McBeath and Meacham, 1992). The Study Guide was a challenge to see what I could do on my office PC, using Word for Windows, a laser jet printer and nobody to assist me. Unfortunately everyone I know who produces fantastic graphics and diagrams uses Macintosh and I had not had any luck importing TIFF or BMP files to the PC. Even our Distance Education people, who would have been happy enough to handle my text on Word for Windows, would have used the Mac to generate the models and diagrams, and would have succeeded once again in wresting control of the final format from me.

I had discussed my first draft with an instructional designer at Distance Education. One of their typists had run my files through their printer and destroyed much of my painstaking page design. Armed with my version and theirs, I put my case for doing my own print out and grudgingly I was given a very special dispensation. Many of you are connected with Distance Education Centres and you know what they are like!

However, the problem of my graphics had still not been solved. Some could be photocopied from originals, but others needed to be re-drawn or drawn from scratch. I also needed arrows, bullets and some form of advance organising symbols, none of which I could generate on my computer. I struggled with Paintbrush for Windows, pouring over an unintelligible Manual written only for the initiated, wondering how I could possibly get my circles to look round, my lines straight and my boxes in the right position on the page. The few things I did get right I couldn't convert. It was frustrating and time consuming and there seemed to be no one in the world prepared to help me. The fact that the final design was so simple in format was as much a factor of what I couldn't do on the computer as anything else.

This section is headed the technological issues. This is a misnomer. The issue in point is that, faced with the pressures of deadlines and submission dates, a unit designer would be lucky indeed to discover all solutions in complex technology. The final solutions to my few outstanding problems were found in simple technology. I had someone else do the diagrams and an artist draw the symbols and arrows. To the photocopier, to enlarge or reduce as needed, and then back to my office with glue stick and invisible tape, where I painstakingly completed the final version manually.

Since then I have used and evaluated the first edition, correcting and improving it with feedback from the students as it was used. I have upgraded to Word for Windows 2 and Power Point. I can generate bullets at will and have learned to transport elephants, horses and city skylines from Power Point clip-art files, change their size and put them into the right place in the text document, if I should ever need them! I have discovered the secret of generating simple symbols in Paintbrush and Power Point and importing them into Word. I can put all kinds of borders, boxes and background shading into my text, and I am working on the possibilities of Zapf Dingbats for the second edition. Desk top publishing is indeed a fascinating technology, but it does take such a lot of time.

The importance of case studies

This is a case study of one person's experiences of desk top publishing. The purpose of case studies is to provide a way of addressing the problem of relevance, in the sense that they reflect what is really happening in all its personal and social complexity (Stake, 1986). They focus on, and interpret, a part of reality which is considered to be significant to the writer and to the reader. As a research approach it has a conceptual structure which presents an understanding of a situation, draws conclusions about it and allows readers to extend these new insights into their own experience and awareness (McBeath & Richards, 1988).

There is a place for case studies in the complex and little understood world of unit design for tertiary students, in that they can provide lessons for others. Others working in the field will relate with my problems and constraints and share ideas about the issues which I felt were important. Some of my ideas may be arguable, others might be enlightening. My account can help bring the debate to light.

Case studies, as retrospective accounts, also provide a record of the intentions of the developer (Wise, 1979; Kennedy & McDonald, 1986). Developmental intentions often become lost in implementation and well designed materials can become distorted and misused (Fullan, 1982). Evaluation studies should have access to such records, so that the outcomes can be compared with what was intended when the package was put together. It could be useful also to know whether the distortion occurred much earlier, as a result of poor design perhaps, or the neglect or omission of data discovered at the needs analysis stage. Distortion can also occur in interpreting the content or in wrongly balancing it between the needs of the students and the demands of the content area. This information should also be available to evaluators, and fed back to the developer for further consideration.

In my own case, as both the content expert and the developer, I was very close to my own material. While this can be valuable, it also has disadvantages in that it may be more difficult to see disjunctions built into the message. In my account of what I wanted to do, comparison can be made with what I actually did do, and corrections can be made.

Finally, writing a retrospective account is useful to the unit writer. It is useful reflection to ask oneself, Why did I do that? How was that decision made? Could I have had more control over this or that section? Did I really consider the best way to do that? Reflection can lead to better practice, and better practice is the only sure route to producing the clever country which this conference is all about.

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Developing style for multi-institutional distance education course development projects

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Traditional materials development in tertiary institutions has typically taken place within closed groups where the locus of control typically resides with individuals within one institution. Materials development with other institutions however, demands a model where responsibility is shared and where specific expertise is recognised.

This paper critically examines the development of a project with particular regard to the typographical, editorial and educational styles which were adopted. A major focus will be on the allocation of particular style development responsibilities within the course team and the subsequent impact on the materials preparation process. The authors' experience suggests that an effective approach to the development of style centres on providing an infrastructure which maximises the use of each team member's skills and creativity. In this way individuals can concentrate on their specific areas of expertise.

The rationalisation of the provision of distance education in Australia has, in, many cases, provided opportunities for higher education institutions to work together in the development of courseware for open learning applications. The utilisation of course teams for the development of open learning courseware has been adequately documented (Gough, 1984; Waller, 1977) and is a model which has gained wide acceptance from many distance education providers.

The establishment of course teams, which provides the basis for the development of quality learning materials, can often complicate and protract the preparation process through the sheer variety of specialist skills which team members bring to the development process. This can be controlled to some degree if the team members are all based in a single institution. However, the development of the Preparatory and Remedial Education Program (PREP), which this paper will discuss, involved the design, development and preparation of a suite of preparatory and bridging courses using development team specialists from a number of Queensland tertiary institutions.

This paper critically examines the development of this project with particular regard to the typographical, editorial and educational styles which were adopted. A major focus will however be on the allocation of particular style development responsibilities within the course team and the subsequent impact on the materials preparation process.

Background

The main goal of the Preparatory Remedial Education Program (PREP) was to produce preparatory and bridging open learning packages in science, mathematics and communications. The courses needed to provide flexible, high quality instructional materials which integrated contemporary teaching-learning methodologies with appropriate multimedia delivery techniques. The materials to be produced were expected to gain widespread acceptability in Queensland higher education institutions, mainly because development teams comprised content specialists from these institutions.

Many higher education institutions had previously developed their own preparatory and bridging courses. The Queensland Government-funded PREP project provided an opportunity to rationalise such courses, improve their quality and establish common programs available that promote transferability of credit in preparatory courses in Queensland.

Considerations in materials development

All Queensland tertiary institutions (TAFE and higher education) were invited to participate in the project. The response was both encouraging and daunting. Seven of the nine Queensland academic institutions became directly involved in the course development process. Involvement of such a large number of institutions and academics presented an unusual project management experience, which added a layer of logistical and administrative complexities to the materials development and design process. Some complications faced in this project were the distances between project members; the need to schedule meetings for large numbers of people making contributions to different working groups and the need to attract and support motivated academic staff with both the required materials preparation skills and credibility within their institutions.

In retrospect, some specific issues that influenced the materials development process have been identified:

- This project was not 'simply' a materials development project. Unlike most course development exercises in distance education, this project started without a defined syllabus.
- The PREP project's mandate demanded inter-institutional participation. In each institution, there was a limited pool of expertise in preparatory and remedial teaching for each subject area. This dictated to some degree the final membership of each subject development group. In the early stages of the project, individual academics expressed strong and often conflicting views concerning appropriate content and teaching strategies for remedial learners in their discipline.
- The time that academic staff could make available to the project was an important consideration. Most academics involved in the project had significant teaching loads and other professional commitments and all were under pressure to

undertake research work or consultancy activities. It is to the credit of the people participating in the project that so much of their time was devoted to the project when this time could have been used to pursue more financially or academically rewarding activities.

- The 'open ended' nature of timelines for the project had positive and negative effects. Student enrolments had not opened so it was difficult to convince writers that deadlines were real. There was sometimes a tendency to seek perfection by repeated alteration of materials; not recognising the demands such a course of action placed on other team members and project budgets.
- Overcoming distance and the cost of working in teams at a distance was a challenge. There was a need to involve staff from tertiary education institutions throughout Queensland-in some cases up to 2 000 kilometres apart. While extensive use was made of teleconferencing, facsimile and mail; face-to-face meetings proved to be essential to promote effective teamwork — particularly when determining subject syllabus, content requirements, assessment procedures, teaching methodology and ensuring consistency between modules prepared by different writers. Contacting team members, arranging flights, transferring funds, preparing contracts and timetabling meetings (teleconference and face-to-face) proved to be difficult tasks.
- Physical distance was not the only barrier to communication. Team members were creatures of the environment of their own institutions and thus had different perceptions of the roles of design and development staff and the amount of control they should effect over media and its preparation.

Materials development process

A sensitivity to budget considerations led to an intensified focus on project management. Relevant information was assembled, project organisation and structures were developed and an initial meeting of all team members was arranged in Brisbane.

Project management and course development guides, based upon the methodologies and experience gained in the design and preparation of distance education materials within UCQ, were presented to the team members at this point and included:

- information sheets explaining the project background
- project briefs and project plans
- project management kit
- team briefs
- subject briefs
- examples of typographical style
- research on target audience
- stimulus papers.

As the PREP project required the development of instructional materials in four specific discipline areas, an academic team (the Subject Team) was established in each of the areas of Mathematics, Chemistry, Communications, and Biology. The role of this team was to:

(a) develop the curriculum/content framework for each subject

(b) work with designers to prepare a plan for the materials to be developed

(c) select writers and validate the work of these writers.

Each academic team included five or six subject specialists from a range of tertiary institutions. Another team (the Design Team) with expertise in instructional design, typographical design, media development and administrative support was formed to:

(a) facilitate the design and development process

(b) keep Subject Teams on schedule

(c) ensure that materials were produced efficiently

(d) ensure materials were educationally effective

(e) ensure consistency across subject areas.

These responsibilities were based on the assumption that the Design Team would have close involvement with each Subject Team and provide liaison while ensuring cohesion between all five Subject Teams to ensure consistency, maintain timelines and provide quality assurance.

Once Subject Team members were brought together it became apparent that the original project plan would require reappraisal. It had been assumed that, because subjects were preparatory in nature and because the academics selected had experience in the area, only a limited amount of time would be required to develop a course curriculum and select writers. These assumptions proved to be optimistic as they did not consider:

- Group dynamics — The initial meeting was the first opportunity for many academics to meet and most were initially unwilling to address the task that had been planned (curriculum development), at least until personal philosophies and ideologies regarding the subject, its teaching and the process to be used for materials development had been resolved. These issues were difficult to deal with at this initial meeting because they required the development of mutual trust between team members, which required time for dialogue between individuals. The expense of assembling teams and arranging suitable times for meetings had produced a task orientation on the meeting agenda when participants were not ready for this. This task orientation was a product of the cost of assembling Subject Teams, involving approximately 20 people from around the State. The expense of this meeting led to the desire for a product from the meeting — something on paper — however the real action that needed to take place was in the interpersonal sphere.
- Curriculum development — This project required more than materials development based on accredited syllabus documents. The need to avoid premature closure of discussion at this planning stage indicated that the curriculum planning time line would have to be extended and extra Subject Team meetings held.
- Experience in materials development — While they had experience in preparing learning materials for face-to-face students, few Subject Team members were

familiar with the nature of distance learning or the development of distance learning materials.

- Teamwork — In preparing learning resources, most academics had worked independently or by mutual agreement in small teams with colleagues of their choice. For this project, subject groups were larger and teams had to work with other project teams. Individuals were also required to work closely with colleagues chosen by the project manager.
- Control — Subject Team members, when developing learning materials for their own use, had tended to develop most of the material themselves and thus were accustomed to asserting a large degree of control over the process and product. The PREP project however, required the involvement of colleagues, designers, media specialists, and production personnel who were charged with particular responsibilities which ordinarily would have been controlled by the author.
- Territoriality — There was confusion and scepticism at the initial team meetings about the rationale of the project. There was a general feeling by Subject Team members that their own institutions had developed and delivered their own preparatory and bridging programs which had proved adequate.

The Design Team had spent some time researching the area of preparatory and remedial studies. Much of this information had been obtained from prospective Subject Team members. The Design Team was keen to present this information and have Subject Teams complete the curriculum planning stage quickly to justify the expense of the initial meeting and to ensure that time and funds would be available for writers to complete their work by the initial deadlines defined for the project. Unfortunately, and for the reasons given above, this task orientation by the Design Team did not allow Subject Teams to come to terms with group dynamics and the curriculum development task. Insufficient time was allocated for the academics to acclimatise to their new team environment. The Design Team was perceived as being too autocratic with a policing role, threatening the individuality of the writers. While many of the team members had conflicting views about their subject and its development, the Design Team became a common focus for dissension. We were reminded that two cardinal rules for course development had been broken — the designer must not be seen to have a policing function (Cook, Nouwens & Bergin 1987, p.26), and the conceptual development stage of materials development should not be brought to a premature focus on content (Houghey 1989, p.51-56). Possibly a new rule could be "A tight budget is no excuse".

It was soon decided that the Design Team should reduce its task orientation to give Subject Teams an opportunity to develop a sense of cohesion, and deal with the issues of curriculum development. This required more face-to-face team meetings than was initially planned. Many team members had experience in preparatory and remedial education, and as suggested earlier, much of the initial information gathered by the Design Team to assist with planning had come from prospective Subject Team members. Because of their experience, it was felt that the Subject Teams could analyse needs and prepare subject plans while the Design Team members would continue to facilitate this process. While tension remained between some group members, this approach was successful in that each subject development team concentrated on course planning, although this process took some time.

It had been intended that Subject Teams, with the Design Team, would prepare a subject plan and select contract writers to develop this plan. The Design Team would then provide workshops for writers, whose work was to be validated by the Subject Team. In reality, most writers were contracted from the Subject Teams.

The trust and understanding that team members developed of each other in the curriculum planning stage paid dividends at the point of validation of the materials. Philosophical issues about the nature of teaching and the requirements of the subject had been addressed so most writers knew what was required. Writers were required to defend their work in detail in an atmosphere of frank and constructive criticism, resulting in rigorous scrutiny of initial drafts.

As expected, the decision to give Design Team members a less prominent 'policing' role in subject development resulted in difficulties in maintaining control of timelines and processes. For example, writers' workshops that were originally planned were not offered because there was a perception within Subject Teams that their members' expertise in preparatory and remedial education and the work done by members in planning subjects had already prepared these people for the task of writing. Subject Teams did not wish to address issues of style development and little documented planning was done for the writing task by the Subject Teams.

PREP style development

Because of an initial lack of attention by Subject Teams to the issue of style, the determination of educational, editorial and typographical style for the PREP program was based upon an incremental development of 'ideas' which evolved as the materials were being prepared by the various writers.

Each writer had individual pre-conceived notions of how materials should be presented. In the writers' minds, these 'ideas' appeared in the manuscript for the model module for each subject, but much of the intended style was implicit in the manuscripts with little or no description of the purpose or layout.

Thus when the model was typeset and returned to the writer and the Subject Team, the response was generally that the style which had emerged from the instructional designer's and typographer's interpretation of the writer's manuscript was unacceptable. At the team meeting held to consider the initial typeset model, it was interesting to note that while the Subject Teams found the initial educational and typographical treatment inappropriate, individual writers and team members had differing perceptions on the appropriate layout of the text and the use of educational techniques in learning materials.

Identifying presentation 'ideas', describing them and agreeing on consistent use of educational features and typographical elements became a lengthy process. For example, in one instance when the typographic designer was asked to attend a Subject Team meeting to discuss optimum presentation formats, it became clear that some of the writers had very strong but subjective preferences about the presentation of their materials. For that particular subject, establishment of a typographical style became a matter of bargaining, experimentation and compromise in order to gain overall agreement on presentation. The experimentation process continued on through many proofing stages until a defined style was developed which satisfied the subject teams' requirements and met established typographical requirements (considering aspects such as readability, legibility and typographic consistency) was finally achieved.

The result of this process of typographical experimentation significantly increased the production costs as several modules of the materials had been prepared before an acceptable presentation style was agreed upon. These modules, of course, had to undergo repeated major revision as the style evolved. The issue raised here is not the addition of new features to the style — a style must grow to deal with the needs of teachers and learners — the problem was one of changing features that had previously been accepted by the Subject Team.

The consensus style-development approach ignored the amount of work involved in training staff in style, in checking for consistency and changing existing typeset materials when such late changes were made. The effect of such changes on materials which had already been typeset involved many revisions, and subsequently considerable production time as various elements of the style were refined. The ongoing experimentation and refinement of the typographic style may have provided a useful learning experience for writers as they came to learn the wisdom of many typographic conventions, but it greatly increased production costs and time.

Discussion

This development experience of the project highlights the importance of group dynamics, which is fundamental to the efficient team development of distance education materials and the need for clearly defined roles–especially in the development of style. While the project has produced materials of quality, the cost of this quality has been significantly greater than for traditional course development because it sought to involve all tertiary institutions in Queensland.

The experiences gained in this project suggests the need to clearly define the roles of all involved in developing learning materials and to support those roles at a management level. It cannot be assumed that roles will be allocated by Subject Teams in a way that promotes efficient and timely production of materials. Subsequent to this project we have found that by providing the writers with a clear description of their role, a defined project style and the tools to implement that style, the time that all team members must spend on a subject can be significantly reduced. By defining the style and then introducing writers to the components of style at the initial writers' workshop, we find that writers develop a better understanding of the techniques that can be used to teach in print and use these techniques more effectively.

It is our experience that style should be defined at the pre-writing stage, and provided it is seen as a means for promoting learning rather than an end in itself, the style can be regarded not as a constraint but as a resource which leads to enhanced productivity and efficiency for the writer, designer, editor and the entire production team.

Conclusion

Traditional materials development in tertiary institutions has typically taken place within closed groups where the locus of control typically resides with individuals within one institution. Materials development with other institutions however, demands a model where responsibility is shared and where specific expertise is recognised.

The team approach to distance education materials development is a well-defined and established procedure for the production of quality learning materials. While this approach has proven to be extremely effective in bringing together the expertise of those people who could be involved in the development process, systems are not always refined to channel the expertise productively.

On occasion there has been tension between the team members responsible for content and those specialists with the particular skills necessary to efficiently develop the content into effective study materials. This situation possibly arose from the traditional culture of face-to-face teaching where teachers are accustomed to maintaining total control over the design, development and delivery of their subject matter. In these scenarios there is typically little to no experience in relying on 'communication specialists' to assist with the teaching process. The team approach to materials development threatens this traditional autonomy. This sometimes results in team members working outside their areas of expertise, thereby losing focus of their own responsibilities. As a result there may be some tension between team members, which can effect the team's productivity.

A productive team approach can be fostered through the recognition by all parties of each team member's professional expertise and responsibilities. The authors' experience suggests that an effective approach is to create an environment in which the skills and expertise of individual team members are recognised and thus productively utilised. This approach centres on providing an infrastructure which maximises the use of each team member's skills and creativity. In this way individuals can concentrate on their specific areas of expertise.

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Global Aspects of Resource Sharing: The Library's Vital Role of Information Transmission

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Not a single library can satisfy all its readers' needs with its physical collections and services, increased emphasis is placed on cooperation or resource sharing among libraries. In addition, more and more information are being produced and distributed, not only in print forms, but in electronic formats as well, with multiple paths of access to this information. The increasing creation, storage, and transmission of information in electronic formats will enlarge and transform the library services nowadays. Facing this challenges, libraries in the 21st century should be able to serve as a gateway to national and international information resources.

The paper discusses several aspects of resource sharing: its development, types, participants and current development in Taiwan. The emphasis is placed on the computerised resource sharing through information network. The four channels of resource sharing: interactive message, E-mail, file transfer and remote login, are also briefly mentioned. Six reasons for library to provide access to academic networks are justified. Besides, the paper explores the prospects and directions of resource sharing activity thoroughly.

Not a single library can satisfy all its readers' needs with its physical collections and services, increased emphasis is placed on cooperation or resource sharing among libraries. In addition, more and more information are being produced and distributed, not only in print forms, but in electronic formats as well, with multiple paths of access to this information. The increasing creation, storage, and transmission of information in electronic formats will enlarge and transform the library services nowadays. Facing this challenges, libraries in the 21st century should be able to serve as a gateway to national and international information resources.

Three Stages in Resource Sharing

The processing development of resource sharing can be described in three stages, these include:

Manual Operation System

At this stage, the primary activities of resource sharing, mainly with library collections, include interlibrary lending, copying of periodical articles, referral services, etc. To facilitate such services, libraries should compile union list of collections, conduct cooperative acquisition, and set up reciprocal rules to be used.

Traditional Information Network

Traditional information network indicates that users of the same mainframe can communicate with each other. Nowadays, most libraries use the library cooperative systems, known as bibliographic utilities, such as OCLC, RLIN, WLN and UTLAS, to facilitate the processes of interlibrary lending, and cooperative cataloguing. The resources sharing in this stage are not only the library collection but also human resource in cataloguing practices.

Open Information Network

Open information network indicates that users of different computer networks linked by the telecommunications channels can communicate and exchange information one another.

The most renowned open information network in the library services is the Linked System Project (LSP). This project first united the Library of Congress, RLIN, WLN and OCLC to develop and exchange authority file records. As of Sept. 1989, there are twenty two bibliographical systems in the United State joined in this online project. (Note 1).

In 1969, ARPANET (Advanced Research Projects Agency Network) developed by the U.S. Department of Defence, started to operate experimentally and successfully connected computer systems in various organisations, including military, universities and research units. This experience led to the booming of open information network. By the 1990s, libraries not only continued their traditional networking services, but also became highly dependent on the open information networks.

Academic network, an open system, is the mainframe to mainframe connection among institutions, government agencies and private research sectors, and this enables- users or participants to use the network to access the online services. The network configuration includes from the small-scale local area network to the large scale national or international network. To use gateway functions, users of different networks can also communicate with others.

Current Resource Sharing in Taiwan

The current status of resources sharing in Taiwan remains in the manual operated system stage. As to the traditional information network, started its operational within the recent few years, can be discussed in domestic and international terms. Domestically, there are two recently developed small-scale systems: TALIS (Tamkang Automated Library Integrated System) developed by Tamkang University, and Chinese CATSS (Cataloguing Support Service) by National Central Library. TALIS began its operation in 1986, and went online with the Taipei City Council Library and the Ministry of Communication Library in 1989 and 1991 respectively. Chinese CATSS was implemented in 1990, joined by several National University Libraries (including Taiwan, Chengchi, Chunghsin, and Chengkung), and later by private university libraries as well.

Internationally, libraries of Tamkang University, Chung Shan Institute of Science and Technology, National Central Library, National Taiwan University are using OCLC's services. However, limited by the costly charge of international telecommunications link, libraries in Taiwan use OCLC chiefly as a problem-solving aid, not as a primary cataloguing tool.

In 1987, The Ministry of Education introduced BITNET (Because It's Time Network), one of the international academic networks, to the academic and research institutions in Taiwan. Through BITNET, they are able to connect their mainframes with computers worldwide. In 1988, Tamkang University library linked BITNET, and from then on it was playing an important role in the library services. This article is mainly to describe, upon three-year's experiences and observations, the impact of the BITNET performance on information resource sharing, especially for the following three areas: participants, types and avenues of resource sharing.

Participants of Resource Sharing

Prior to the pervasiveness of academic networks, activities of resource sharing were mainly implemented by libraries and information centres. Now whoever connecting to the networks, be it individuals or institutions, can share in others' resources and problem-solving techniques. There are three types of participants:

1. Libraries and information agencies;

2. Computer networks and their nodes; and

3. Users of the computer networks.

Except the first group, the rest are all newly added ones.

Because of the broad scope the network covers, there are no accurate statistics on its membership so far. Up to now there are about 2,000 networks that can be communicate to one another, (Note 2) and hundreds of thousands of nodes within each network; e.g., BITNET has now over 3,000 nodes. (Note 3) There is also no comprehensive directory of participants available for public use. The information Centre of the U.S. Department of Defence (NIC.DDN.MIL) has established a database, a list of the related information network participants, to provide the public for online search.(Note 4) To locate the nodes included in each network can be found out in network directories. Nodes covered in BITNET, for instance, are stored in the BITEARN database.

Types of Resource Sharing

Resource sharing could be divided into three types: Traditional library materials, human resources and computerised resources.

Traditional library materials, indicating non-computerised resources, such as monographs and periodicals, still constitute the majority of the interlibrary loan workloads, processed through manual operated and traditional information networks. However, nowadays, academic networks have already been one of the best channels for acquiring library materials, as -well as for human resource sharing. The electronic forums, providing groups discussions about the transactions of interlibrary loan such as ILL-L in BITNET, and LIS-ILL in JANET (Join Academic Network, UK), are good examples.

From the contents of the lists of library-oriented discussion groups on BITNET, JANET and Internet the discussion of human resources sharing has gone beyond the cataloguing area to include other operational personnel as well. Among them are: NOTISACQ on acquisition; AUTOCAT on cataloguing; LIBREF-L on reference service; ILL-L on interlibrary loan; BI-L on bibliographic instruction; CIRCPLUS on circulation; GOVDOC-L on government publications; CDROM-L on CD-ROM and PACS-L on public access computer systems. Topics related to various types of libraries include: ARLIS-L on art libraries; BUSLIB-L on business libraries; MLA-L on music libraries and LAW-L on law libraries. Furthermore, there are several topics mainly discussed on the library automated systems, such as ATLAS-L, INNOPAC, NOTIS-L, GEAC-L, BRS, etc.

Computerized information resources are probably the richest resources the academic networks can possibly provide, namely, online catalogue, information retrieval (IR) system, bulletin board system, electronic text, computer software and others, which are provided mostly by the research libraries and institutions.

1. Online Catalogue

Many libraries and research institutions allow users with individual terminals access, via academic networks, to their library catalogues without charge. Usually, users can reach the remote library online catalogues by using, TCP/IP (Transmission Control Protocol / Internet Protocol) remote login protocol, i.e., TELNET, which is implemented on most networks of dedicated links. The login and operation instructions and the IP addresses of systems available are listed in detail in the following directories:

1 Internet Library: Compiled by University of New Mexico. It covers online catalogues, campus information systems, and other IR systems from hundreds of libraries in U.S., Mexico, Australia, Germany, Canada, Israel, New Zealand, Switzerland, etc.(Note 5)

2 UNT's Accessing Online Bibliographic Databases: Compiled by Northern Texas University. It covers a list of the U.S. and British libraries' online catalogues. (Note 6)

3 OPACs in the UK: Compiled by Sussex University. It covers the catalogues of sixty-one British libraries and the application instructions of JANET, IXI (International X.25 Infrastructure) and Internet.(Note 7)

2. Information Retrieval (IR) System

An information retrieval system is a system in which information is retrieved electronically via the network by the user on demand. Many university libraries offer such systems through academic networks to their primary users, and even to the remote clients. The Internet Library data file lists not only the online catalogues of major libraries in the United States and in other countries, but also the IR systems offered from these libraries. Institutions other than libraries have also provided a wide variety of IR systems. Some of them are referred to as the servers of the network, and some are used independently as the database retrieval system. BITNET List servers, for instance, provide excellent database retrieval functions; and ASTRA (Application System and Technical Report for Academia), a joint project of IBM and Italian National Research Council, aims to design a free service for the distribution of information about academic projects in education and research. Unfortunately, there is no one comprehensive directory for this system as yet. Some useful sources are: the file "BITNET Servers" lists those databases available from BITNET; (Note 8) PEERS database covers a name catalogue of nodes to which BITNET List servers are provided; (Note 9) Internet Resource Guide, compiled by NSF (National Science

Foundation) Network Service Centre (NNSC) is an indispensable tool to search the catalogue of public information systems in each network.(Note 10)

3. Bulletin Board System

Bulletin Board system in academic networks, usually used for posting messages, is also used for discussions within continuous topics in the recent. Some bulletin board systems, mostly provided by institutions other than libraries and information units, can even store messages and texts classified by subjects, and allow keywords search with boolean logic functions. One example is ISAAC (the Information System for Advanced Academic Computing) of Washington University, which is sponsored by IBM to facilitate the use of IBM and compatible machines as the aid to instruction and research in higher education. ISSAC is open to all faculty, students at institution of higher education to members of participating professional societies.

4. Electronic Text

Any computer-generated monographs, periodicals, articles, reports, or manuals, known as electronic texts, to which users in the networks can have free access without any restrictions of copyright or useright. The providers of electronic text are usually the information centres of networks or nodes, or individual users; e.g., the nodes in BITNET implementing List server, or the sites providing anonymous FTP (File Transfer Protocol) function are good sources to acquire this kind of data. (Note 11) In addition, the Information Centre of the Department of Defence (NIC.DDN.MIL) as well as National Science Foundation (NIS.NSF.NET), keeps a record of RFC (Request for Comments) documents, which are important literature regarding the use of computer networks. The large amount of electronic texts offered are worthy resources to be shared and collected.

5. Computer Software

Computer software is one of the important and easily available resources in academic networks. It ranges from electronic spreadsheets, simple IR systems, communication softwares, and application softwares of various subjects, to complicated systems; such as, the software for running BITNET List Server, and Netnews software for UNIX system and VM/CMS system. Some software packages have thousands of users. Netnews software, for instance, has its users of more than 6,000 in 1989.(Note 12)

6. Others

(1) Shared Online Channel

The charge items for a fee-based information system consist of a communication fee and a database search fee. In order to reduce the cost of communication channel, some systems including bibliographic utilities started to provide remote login functions, via academic networks, for users to go online. Those systems include RLIN (IP address, RLG.STANFORD.EDU), (Note 13) OCLC EPIC (IP address, EPIC.PROD.OCLC.ORG), (Note 14) and the law database, LEXIS. (Note 15) Users can save a considerable amount of communication fees by going online via academic networks, and that is also a breakthrough for the information retrieval service that libraries can provide.

(2) Integrated Service in Hardware, Software and Peopleware

One of the most important advantages of academic networks is that users can get together exploring answers for the problems or questions they meet. For example, many networks use functions of anonymous FTP to provide electronic texts and programs for users without charge. Since there is no password restriction for-using anonymous FTP, it is actually open to everybody. Many valuable research reports and literature can be acquired by anonymous FTP. At the present stage, however, users of BITNET cannot execute the FTP function, thus, these free information resources are really unaccessable for them. In view of this situation, Princeton University took action in developing a mail interface to allow BITNET users to FTP files from sites on the Internet. The address is <BITFTP@PUCC>. Users can send e-mail containing their commands to that address to acquire the documents they need.

(3) Redistributed Service

For those networks that are not able to connect to each other, there is a redistributing service for them. A newsgroup, on the USENET, called SCC (Soc.culture.China), for instance, has been established as an effort to promote communications and understandings among Chinese students and scholars who are interested in China affairs and problems, a voluntary redistributing service now stationed in Waterloo University, which is one of the BITNET sites that carries USENET newsgroups. Waterloo loads news from USENET and stores them in files and sends them to the users at BITNET. In this case, users at BITNET can also share resources available in USENET.

Avenues of Resource Sharing

The availability of academic networks has expanded the channels of resources sharing for library cooperating systems. Traditional library cooperating system is still the main channel for providing interlibrary lending and copying of materials as well as cooperative acquisitions and cataloguing. Mailing is still the primary method of document delivery, sometimes it is aided by FAX according to services needed. The newly added types of resource sharing channels include interactive message, electronic mail, file transfer, and remote login, which will be described briefly.

1. Interactive Message

Interactive message, a simultaneous correspondence among the computer networks located in geographically distant sites, is the easiest way for issuing command to acquire electronic texts programs.

2. Electronic Mail (or E-mail)

E-mail is widely used in transferring and processing large amount of message fast once the mailing list is set up. Currently E-mail is highly used for transmitting not only messages but also electronic documents.

3. File Transfer

It functions similarly to e-mail, but it is used mainly in transferring electronic documents, programs, etc.

4. Remote Login

Remote login can be used in searching databases or files, as well as executing the various software packages from the computers located in the distant sites. The recently opened online catalogues, IR systems or other files provided by major libraries are done through this channel. The major communication protocol now available is TCP/IP, which provides two important functions of remote login for Telnet and file transfer for FTP.

Reasons for Library Connecting to Academic Networks

Under the environment of academic networks, users can access to the rich variety of resources mentioned above independently and directly through terminals located at home, in the office, in a laboratory or other location. How can a library justify the primary reason for its existence — to provide access to academic network resources? Authors think that libraries can provide user access to academic networks resources for the same reason that libraries have provided users physical access to books and periodicals. The reasons for library systems connecting to the academic networks are:

1. *Centralising of Resources Enable the Users to Save Time.* Data of academic networks are scatteringly stored among their nodes. The user has to find out their locations before he/she can use it. The library can save users a considerable amount of time by acquiring these resources and putting them in one place.

2. *Simplifying Information Retrieval Methods*: Different application software used in the network require different commands to retrieve information, which usually causes confusion to users in communication with the systems. To simplify the processing of searching information from the networks, a practice could be carried out by library to collect those electronic documents and provide utilisation in one system. The following are four examples of commands in e-mail to retrieve information from different networks:

Example 1. To get data file from <Listserv@BITNIC> in BITNET

```
    get listdb memo
```

where (get) is the command in retrieving file, (listdb) is the file name and (memo) is the file type

Example 2. To get data file from <info-server@SH.CS.NET> in CSNET

```
REQUEST: NSFNET        (Preceded by <REQUEST:> specifying directory name.)

TOPIC: HGI

TOPIC: LINK-LETTER-15  . (Preceded by <TOPIC:> specifying file name)

TOPIC: REPORT-8908
```

Example 3. To get data file from <mailbase@NEWCASTLE.AC.UK> in JANET.

```
    get lis-info internet-opacs.intro
```

where (get) is the command in retrieving file. (lis-info) is the directory name. (internet-opacs.intro) is the file name.

Example 4. To get data file in <mail-server@PITmanager.mit.edu>

```
send USENET/news.announce.newusers/answer-to-frequently-asked-
questions
```

where (send) is the command in retrieving file, (USENET/news.announce.newusers) is the directory name, (answer-to-frequently-asked-questions) is the file name.

3. *Enabling Users to Utilise the'resources Fully:* Usually the academic networks do not charge to users. However, each network has set up its own rules to eliminate the searching traffic. For example, in BITNET Listserv, each node will limit remote users to 256k bytes per day in retrieving information, which apparently are inconvenient for users doing research work. Libraries therefore, should collect those materials systematically and periodically for as a part of library collections from the networks and provide easily access and utilise the resources to their patrons.

4. *Effective Use of Academic Network Resources* Computer networks are an efficient communication channel open to individuals. However, they still need to be planned effectively in order to make the most use of it. For instance, on one occasion when it was introduced in a seminar that there are over a thousand RFC files can be retrieved from <NIS.NSF.NET>, too many users in the Taiwan area linked these files at the same time, causing the network to be jammed, and even affecting the operations of other functions. the Computer Centre of the Ministry of Education has to announce that RFC data files are stored in the Listserv, and that user should avoid searching directly from abroad.

5. *Some Resources in the Academic Networks Are No Longer Published in Print Format:* Because of convenience of the academic networks in publishing and transferring information, many documents are now published electronically via the networks, and are no longer available in print format. For example, materials from the forums or discussion groups, or even some periodicals, such as PACS Review (Public-Access Computer Systems Review); PACS News; Newsletter on Serials Pricing Issues; and Netmonth are all in electronic forms. Therefore, any library aimed at providing comprehensive information services can not afford to ignore these electronic materials.

6, *Academic Networks Are One of the Most Speedy Ways of Transferring Messages:* Academic networks can pass messages so quickly and conveniently, many announcements of conferences and new publications, new products are made through them. Libraries, therefore can provide the most up-to-date information via academic networks.

As a summary, it is necessary for libraries to provide to access to academic networks, and integrate them into their collection and services.

Prospects

There are totally nineteen nodes of thirteen institutions of higher learning and research units in Taiwan, see Appendix 1, joining BITNET, and making available for domestic and international communications, after it was introduced in 1987.

The establishment of TANET (Taiwan Academic Networks) was accomplished in 1990, which will substantially enhance the functions of the academic networks within the island. See Appendix 2. TANET adopts TCP/IP communication protocol to provide FTP and TELNET functions for transactions of online file transfer and for remote login, which BITNET lacks. TANET really forms an infrastructure for the communication among nodes, intercollegiate and universities networks.

The project of connecting academic networks worldwide using TCP/IP protocol is undertaken, scheduled to be completed in this year. Once the project is completed, the abilities in connecting academic institutions of other countries will be greatly enhanced. Together with this new communication channel, resource sharing activity should be planned in the following directions:

1. *Cooperative Acquisitions of Networks Resources:* In recent years, the number of academic networks have grown rapidly all over the world. The networks resources flourish, libraries should plan to apply the networks resources in the most effective ways by cooperative acquisitions, which could be shared among the libraries according to the participating network, area, or related subjects.

2. *Bibliographic Control for Electronic Documents:* For effective use of the materials being acquired, they should be organised systematically, i.e. be catalogued. Current cataloguing rules do not totally cover electronic texts. It should be the first priority for libraries to draft cataloguing rules for this new type of materials. Special attention should be considered in the rules for the characteristics of this type of materials, such as file name, file type and kinds of typesetting.

3. *Design the Best Way to Provide Services in Electronic Documents:* Electronic documents have their own characteristics, such as, they are mostly generated and circulated through computer network. Therefore, libraries should explore currently available softwares when providing such services. For example, the file transfer function in BITNET List servers have gained recognition, e.g., its AFD (Automatic File Distribution), FUI (File Update Information) and Sendme or Get (commands for file transmission) are all good examples for handling automated request for documents.

4. *Use It Correctly and Efficiently:* After the establishment of an academic network in Taiwan, each node began collecting large amounts of electronic documents. However, because of the lack of bibliographic control, many domestic users do not realise their existence, and often search individually and directly via international channel. Therefore, users should get information from resources available channels and should be educated for the correct way to use this service.

5. *Facilitate the Sharing of Traditional Library Materials:* Monographs and periodicals are still major collections for libraries and are still highly demanded in interlibrary loan. The e-mail function in academic networks can facilitate and simplify interlibrary loan operations. A name-address directory should be issued first before e-mail can be used effectively in processing interlibrary loan.

6. *Use Academic Network to Form Library Network:* A pilot project of online cataloguing sharing system in Taiwan, conducted by the National Central Library, started in 1990. Some libraries even reclined their memberships from this cooperating system, because of the expensive communication fees. Now that TANET is established, it can very well be used as a base for the development of more convenient and efficient library cooperative programs.

7. *Encourage to Form Discussion Groups for Better Human Resource Sharing:* The widely used of academic networks should be taken into account in the design of human resource sharing. Libraries should be encouraged to form or to participate the discussion groups of the library-related topics which will enhance the effectiveness of library services.

The utilisation of academic networks is becoming increasingly important in day-to-day operations. Within the library environment, the academic networks can be used to support a variety applications of management, including information transmission and documents or file transferring. The creative use of such networks will facilitate the activities of resource sharing thereby benefiting the library and its patrons.

Notes

1 NACO LSP Libraries Now Number 22 LC Information Bulletin vol. 48 no. 48 Nov. 27, 1989 p.418.

2 Tracy LaQuey The User's Directory of Computer Networks. Bedford, MA: Digital Press, 1990, p.194.

3 "BITNET overview" Dec. 18, 1990. This file could be obtained from <Listserv@BITNIC>; public use area of TWNMOE10 node; etc.

4 NIC.DDN.MIL provides a /who is system for this purpose.

5 "Internet Library" file could be obtained from <Listserv@ UNMVM>, using the command, "get internet library". The latest version of this file is separated into 4 volumes, i.e., catalogue text1, catalogue text2, catalogue text3 and catalogue text4. They all could be obtained using the command, "get library package", in <Listserv@UNMVM>.

6 UNT's Accessing Bibliographic Databases is maintained by the University of North Texas. The file could be obtained in anonymous FTP at the node <vaxb.acs.unt.edu.> Since FTP function is not available now in BITNET, users in BITNET can get this file via <BITFTP@PUCC> by using the commands listed below in e-mail.

```
FTP vaxb.acs.unt.edu user anonymous get libraries.txt quit
```

7 OPAGs in the UK could be obtained from <mailbase@NEWCASTLE.AC.UK> via e-mail, the command is "get list-info Janetopacs"; or from <info-server@NSFNET-RELAY.AC.UK > via e-mail, the commands are listed below:

```
REQUEST: LIBRARIES
TOPIC: JANET-OPACS
```

8 "BITNET SERVERS" could be obtained from <Listserv@BITNIC> by the command, "get bitnet servers".

9 The list of Listserv, system name of List Server, in BITNET could be obtained by searching the PEERS database. Connect to the nodes which provide PEERS database, then using the commands listed below:

```
search * in peers index
```

10 Internet Resource Guide could be obtained from <NNSC.NSF.NET> via anonymous FTP in directory resource-guide or send a request message by e-mail to <resource-guiderequest@NNSC,NSF.NET>.

11 The list of anonymous FTP is posted to <comp.misc>, <comp.surces.wanted>, and <alt.sources.wanted> on USENET and is distributed via anonymous FTP from <pilot.njin.net> as well as being available from several other FTP sites. On BITNET sites this list could be obtained from <Listserv at UTORONTO> by using the command "get ftp sites", or from <Listserv at MARIST> by using the command "get bitnet ftplist", or send an e-mail to <bitftp at PUCC> by using the command FTPLIST, etc.

12 NETNEWS User's Guide for NETNEWS Version 2.3 revised Mar. 1990 p.1. This file could be obtained from public disk area in TWNMOE10. It's identification, file-name file-type, filemode, is <NETNEWS LISTING E>.

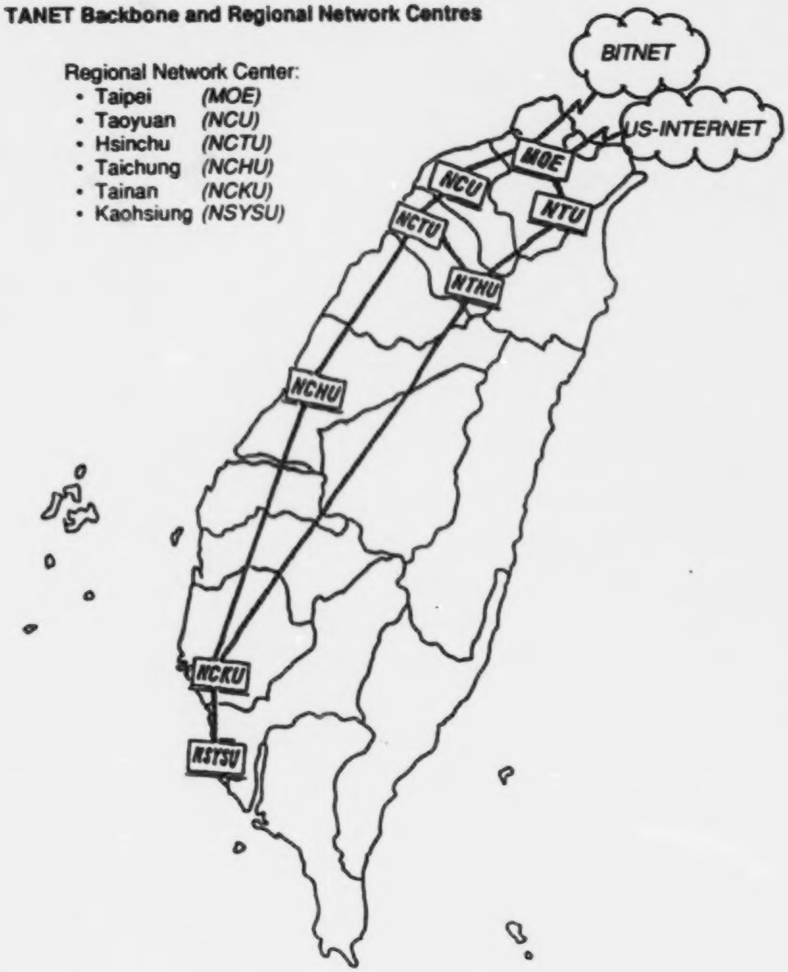
13 RLIN's IP address could be found in the files "Internet Library", UNT's accessing On-Line Bibliographic Database, or Internet Resource Guide, etc.

14 OCLC EPIC's IP address could be found in UNT's Accessing On-Line Bibliographic!-Database, or in "The Internet" OCLC Reference News No2, Jan/Feb 1991, P.5.

15 Law-lib discussion group <message on 8 Apr. 1991>.

Appendix 1: BITNET Nodes in Taiwan

Ref#	Conn	Nodeid	Site name
2555	89/05	TWNAS886	Academic Sinica Computing Center VAX8530
2556	88/10	TWNCTUCS	National Chiao-Tung University Computer Science and Information Engineering
2557	88/09	TWNCTU01	National Chiao-Tung University Computer Center VAX1
2558	91/02	TWNCTU02	National Chiao-Tung University--Computer Center VAX2
2559	90/03	TWNCU865	National Central University — Computer Center
2560	91/02	TWNFCUC1	FENG CHIA UNIVERSITY — INFORMATION CENTER
2561	90/03	TWNIAMS	Academia Sinica — Institute of Atomic and Molecular Sciences
2562	90/07	TWNIII1	Institute for Information Industry — Computer Center
2563	89/03	TWNITRI1	Industrial Technology Research Institute
2564	91/02	TWNMOCTL	TELECOMMUNICATION LABORATORY -- COMPUTER CENTER
2565	87/06	TWNMOE10	Ministry of Education Taiwan
2566	88/08	TWNMOE20	Ministry of Education Taiwan
2567	89/01	TWNNTIT	National Taiwan Institute of Technology Compter Center
2568	87/09	TWNSCU10	Soochow University
2569	89/11	TWNSRRC1	Soochow University
2570	90/11	TWNTKU10	TAMKANG UNIVERSITY — INFORMATION CENTER
2571	89/07	TWNTTIT	Tatung Institute of Technology
2572	89/01	TWNTUCC1	National Taiwan University Computer Center VAX2
2573	89/01	TWNTUCC2	National Taiwan University Computer Center CYBER 825


TANET Backbone and Regional Network Centres
Regional Network Center:
• Taipei (MOE)
• Taoyuan (NCU)
• Hsinchu (NCTU)
• Taichung (NCHU)
• Tainan (NCKU)
• Kaohsiung (NSYSU)
BITNET
US-INTERNET
MOE
NCU
NTU
NCTU
NTHU
NCHU
NCKU
NSYSU

Appendix 2

TANET Backbone and nonional Network Centers

Taken from Yen Chiu Fu Wu Chien Hsiun (Newsletter of Research Service), Computer Center, Ministry of Education, No. 8002, Feb. 1991, P. 12

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Identification of Suitable Distance Education Technologies in the Anangu Teacher Education Program

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The Anangu[1] Teacher Education Program (AnTEP) at the University of South Australia provides teacher education to traditionally oriented Aboriginal people in remote community situations. A research project is investigating the use of distance education technologies to enhance the delivery of the Program. The five stage process developed by the Telecommunications Development Centre at the University of Minnesota is used as a framework for the adoption of suitable technology. This paper documents the first stage in that process, an analysis of the factors considered critical in the successful adoption of technology. In particular the concept of distance is explored. Suitable technologies are identified and some specific applications are proposed.

The Anangu Teacher Education Program (AnTEP) at the University of South Australia (U-SA) provides teacher education for traditionally oriented Aboriginal people. Graduates of the Program teach in primary schools in their own communities in remote Australia. A research project is currently being conducted to explore ways of enhancing the educational experience of students through the use of distance education technologies.

The adoption of technology by an organisation is a complex issue. Morehouse and Stockdill (1992,p57) see it as:

> the result of interrelated actions, forces and political decisions.

In cross-cultural situations such as this, there is another array of issues. These cultural issues add a further layer to this complexity. Though there are profound differences in world views, Anangu people have consistently demonstrated their willingness and capacity to embrace innovation where they recognise it to be of value in their cultural context.

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[1] Anangu is the word used by Pitjantjatjara people to refer to themselves.

The AnTEP Model of Delivery

AnTEP is offered to some 50-60 (mainly fulltime) students in remote parts of Australia. At present there are students at Fregon, Ernabella, Amata, Indulkana, Mimili, Nyapari and Pipalyatjara in the north west of South Australia, at Warburton and Tjukarla in the adjacent central desert area of Western Australia, at Yalata in the west of South Australia, and at Yipirinya School in Alice Springs. There is significant variation in the isolation of community contexts, the Alice Springs site being the least affected.

The curriculum is delivered primarily in face-to-face workshop sessions conducted by specialists in the various aspects of the curriculum. This model of delivery has been developed to take account of specific socio-cultural and pedagogical concerns in the context of teacher education. The workshops are conducted at one of the local communities and are usually one week in duration. Students attend several workshops a term and for the remainder of the time continue their study in their own communities under the supervision of on-site lecturers or tutors.

Study undertaken in the home community on a continuing basis includes assignments and follow up work arising out of workshops, modules of 'course work' which do not require intensive face-to-face input, and school classroom based activities. Because the primary delivery method of AnTEP is face-to-face, the program is best designated as an example of the off-campus mode.

Impetus for the Consideration of Distance Education

In the present economic climate, there is considerable pressure to provide quality education at bargain prices. Distance education incorporating communication technologies is an attractive proposition since it holds the promise of reducing the cost of the human capital component in delivery. Recently federal bodies have funded significant research activity with a technology focus. It is seen to be the key to achieving significant reductions in the costs of higher education while meeting unprecedented demand for places from the community and in catering for access of disadvantaged groups.

Funding for AnTEP has always been problematic. Because of the delivery mode, AnTEP costs considerably more than other mainstream campus based programs but current funding models do not take these extra costs into account. Because the levels of funding do not match the actual cost of delivery, there is considerable pressure to reduce costs. It is acknowledged that costs are inevitably a consideration in offering any program, and that accountability for the costs incurred is only reasonable. However, there has been a deliberate strategy to treat reduction of costs in a different context.

Instead, the focus of the enquiry has been on the provision of quality educational experiences for students, and appropriate working environments for staff, in the very remotest corners of the state. The use of distance education technologies and methodologies to complement the face-to-face mode of delivery is seen to be a way of achieving this.

A Model for the Adoption of Technology

While acknowledging the economic backdrop to the current higher education enterprise, the selection of technologies needs to take into account a range of other issues. Morehouse and Stockdill (1992,p57) advocate the Technology Adoption Model which involves five stages.

1 front-end analysis

2 prototype development

3 small scale implementation

4 organisational adoption

5 institutionalisation

These five stages indicate the focus of various kinds of activity which are undertaken in the adoption of technology. However, the reality of the adoption of technology is a more dynamic and iterative process than the linear one implied here.

The remainder of this paper will consider the front-end analysis undertaken by the project as part of the first stage of the adoption model.

Factors in the Selection of Distance Education Methodologies and Technologies.

Stockdill and Morehouse (1992) have identified five critical success factors in the development and use of innovative technologies. They specify these as:

1 educational need,

2 user characteristics,

3 content characteristics,

4 technology considerations,

5 organisational capacity.

In addition, it is necessary in this particular consideration to include another:

6 the capacity of the telecommunication infrastructure available in the target areas.

It is the degree of fit at the interface between these factors and the technologies that determines whether the technology will be successful. This framework will now be used to consider the AnTEP situation.

Identification of Educational Need

Stockdill and Morehouse (1992,p57) emphasise the importance of identifying the generating needs as an initial step in the first stage, and then selecting specific technology to meet those needs. This is in sharp contrast to the more usual tendency of finding an educational use for an identified technology. In AnTEP, this is a particularly important point because the technology must fit in with a variety of other forms of delivery which together make up a distinctive configuration of educational activity based on social, cultural, political and pedagogical givens. In particular, the Program has a fundamental commitment to the empowerment of Aboriginal groups and individuals in society through education and a recognised need for the student group to remain in their own communities.

The focus of the need is encapsulated in the notion of 'distance'. There is a need to both reduce distance and keep distance.

Geographical distance needing to be bridged results in three clusters of concerns:

distance from the resources (human and other) available at the main campuses of the University

distance of individual students from their peer group

distance of individual staff from the University environment (and in most cases from each other)

In addition, there is a further but just as pervasive notion of 'distance' operating. In the interests of the preservation of Aṉangu culture this distance needs to be maintained. It is best described as:

'distance' from the dominant culture

Distance education approaches and in particular telecommunications systems have the potential to address these concerns. They bring a range of educational benefits to students while maintaining the all important social and cultural context. Furthermore, they provide the possibility of quality professional support to academic staff.

Distance from the resources of the main campuses of the University

Locating the Program in the communities of the students concerned is essential in terms of social and cultural considerations. Using distance education technologies and methodologies, the distance of the remote locations from University resources can be minimised. Specifically at issue is easy access by students and staff to:

the expertise and services of academic and administrative staff,

research facilities at the Library, and

administrative information.

Distance of individual students from their peer group

The numbers of students at each community is small. Furthermore, the students at any given community are usually working on different parts of the course and so the opportunities for peer group interaction concerning AṉTEP work is minimal. Interaction among students is an important aspect of the Program. It is through critical practice and reflection of students in their own context that a distinctively Aboriginal pedagogy develops. Group activity is considered to be an important part of this process.

Though workshops do provide opportunities for students from various communities to interact in peer groups, on-going interaction with those from other communities is an issue.

Distance of individual academic staff from the University environment

On-site lecturing staff in these remote communities are entitled to at least the same levels of research facilities, systematic access to the University decision making processes, and professional development opportunities that Adelaide based staff enjoy. Collegiate support is important for staff morale and cohesion, and so that the unique contribution of each lecturer can be maximised. Though this is clearly an issue affecting the professional lives of individual lecturers, it also impinges on students through the quality of the educational environment on-site.

'Distance' from the dominant culture

This notion of 'distance' refers to cultural distance. It is only as the Anangu keep their distance, that they are able to preserve their culture. The problematic here is not in reducing the distance but in maintaining it. The need is to offer an educational experience which minimises cultural intrusion. It needs to be flexible enough to work within both worlds: to fit into the cultural context of the students while fulfilling the requirements of the University.

User Characteristics

The vast majority of students are mature women. Many of them have had long term experience as Aboriginal Education Workers (AEWs) working along side European staff in the communities' schools. Generally, students have had little background in technology though they show an interest in applications such as word processing and laser disc.

The technological background of staff in the remote locations is variable. Because local expertise to support such endeavour varies from community to community, students and staff will need to attain relatively high levels of self management. Language is an issue. Most students generally have low levels of literacy, and operate in social situations where English is not their first language.

Content Characteristics

Content is a determining issue in the selection of appropriate distance technologies. In respect to students, content in this context can be defined as the curriculum. In respect to staff, content concerns functioning as a professional within the University context.

Curriculum concerns, specifically identified for delivery by distance means, should drive the technology for students. The AnTEP curriculum is dynamic, requiring a high degree of interaction and negotiation, essentially because of the cross-cultural nature of the activity.

Where staff are concerned, the content focus is related to the provision of a climate which enhances professional activity. Facilitation of communication within the institution and throughout the academic world is an issue. As a matter of equity, lecturers in remote locations need access to the decision making processes of the University. Infrastructure for research activity is also required.

Technology Considerations

There are a large number of distance technologies currently in use in Australia. Elliott (1991) and Robson et al (1991) outline the various technologies and their characteristics. In the context of this project, the following have been considered:

Analogue Technologies: audio conferencing, video conferencing, talkback television, educational television, talkback radio, fax.

Digital Technologies: advanced learning technologies (laser disc, CD Rom, interactive computer learning packages), audiographics, laser disc, electronic whiteboard.

The analysis of educational needs, user characteristics and content indicates that there are two essential characteristics for the successful use of technology in AnTEP:

- interactivity among staff/students, student(s)/student(s) and staff/staff, and
- flexibility.

Interactivity

Increased opportunity for interactivity is a major issue for AnTEP students. A number of the technologies considered offer either synchronous or asynchronous interactivity. Synchronous interactivity such as use of the telephone gives immediate feedback, but has the disadvantage of tying both the sender and receiver to a specific time. Asynchronous interactivity such as e-mail provides flexibility in respect to time but does not provide immediate feedback.

Both synchronous and asynchronous technologies have the potential to contribute in valuable ways to the Program. For example, interactive potential of electronic mail is considered by D'Souza (1992) who points out the considerable interest in using this technology in general academic settings.

Flexibility

Flexibility is an essential aspect of AnTEP. If students are to be successful, the Program must take into account cultural and social obligations of students. For example, interactive broadcast which locks students into a tight time frame is likely to be difficult to maintain. Audio conferencing, on the other hand, has greater flexibility. Even though it is synchronous, there is a greater degree of flexibility because of its considerably lower costs, and the fact that it is not dependent on the use of special facilities.

Another aspect of flexibility is in respect to the equipment itself. Because of limited funds, it would be an advantage for the technologies selected to be multifunctional. Computers have such a capability. They can be used as word processors, to send e-mail, searching the library catalogue, to run instructional packages etc. Electronic white boards, on the other hand, are limited to one use, important though it might be. Using these criteria, a number of technologies were selected for the prototype development (stage 2 of the adoption model).

Organisational Capacity

The organisational capacity to sustain and support the technology innovation is a major consideration. As indicated above, costs are a significant constraint. Because there is pressure to reduce costs, realistically there is little likelihood of significant amounts of additional money becoming available. Costs incurred for both capital and recurrent costs should be met through either the present internal costing structures of the University, or through the acquisition of specific outside funding.

A substantial computing system already exists within the University. Remote access to the Library catalogue, and the facilities of AARNET including e–mail, bulletin boards and file transfer are currently available.

The capacity of the telecommunication infrastructure in the target areas

The telecommunication infrastructure in the remote locations (all except Alice Springs) in which AnTEP operates is limited. There are small numbers of telephone lines in most places and these are unreliable. Because of the limited number of lines, there is considerable competition for existing services. Access to the telephone lines must be negotiated through the community Councils.

A new system which will double the capacity and increase reliability is currently being installed at Ernabella, Fregon and Mimili. It will provide a limited ISDN service and is expected to be completed by 1994.

Appropriate Distance Technologies for Aṉtep

Stage 2 of the adoption model focuses on the construction of a prototype. After consideration of the above factors and the nature of the various technologies, the following technologies have been identified as appropriate for implementation or development:

audio conferencing

audiographics

computer connections to University networks including AARNET, Quickmail, etc.

The selection of computer and audio as the basis of the technology to be used, gives the kind of interactivity and flexibility required. It is within the funding structures and can be supported by existing staff. Other technologies already in use, such as fax and video, will be incorporated as appropriate.

Applications of Distance Technologies and Methodologies for Aṉtep

Stage 3 of the adoption model is the small scale implementation of the technology. Three sites have been selected for the trial. Sites will be equipped with a graphic user interface system consisting of a computer, modem, printer and software. Handsfree phones will also be installed.

A number of applications which encompass both student and staff use have been identified for trialling. There will be on-going monitoring, evaluation and review by staff and students through the procedures currently in place. These include student evaluation questionnaires, (staff) Workshop Reports and staff meetings.

The following specific applications are planned:

- Audio conferencing as pre-workshop preparation and post workshop follow up.
- 'Coursework' modules to include as part of the design, the requirement to contact other students or staff outside the local situation.
- The development of a workshop (Writing for a Purpose) for print/teleconference delivery.
- The use of audiographics in the teaching of aspects of language.
- Aspects of workshops which require specialised input from others (such as explanations in the vernacular) to be delivered through audioconferencing.
- Staff meetings conducted by teleconference.
- Staff development sessions on aspects of the curriculum to be delivered by print/teleconference.
- Electronic mail to be used as a means of daily communication: student(s)/student(s), staff/student(s), student/staff and staff/staff.
- Access to the University Library catalogue for searching and placing of holds on items.

Conclusion

Teacher education for Anangu and other Aboriginal students serviced by AnTEP is an essential link in the social empowerment process. Distance education technologies have the potential to enhance the educational experience of traditionally oriented Aboriginal people in remote parts of Australia by providing access to human and other resources. By delivering these services through technology there is increased access and less intrusion into the culture.

For staff in remote locations, the technology has the potential to increase access to the collegiate networks of the University and facilitate the involvement of staff in the decision making processes of the University. Computer based technologies and audio conferencing are considered the most appropriate technologies to trial in the Program.

The five stage Technology Adoption Model is a framework for understanding the aspects of the process. However any human endeavour, particularly in cross-cultural contexts, cannot proceed in the linear fashion implied by the model. The model has been adapted to include on-going evaluation and review of former stages with the resultant realignment of direction.

The first stage of the model, front-end analysis, seeks to identify appropriateness of technologies by analysing six contextual factors. The degree of match at the interface between these factors and the technology is considered an indicator of the likely success of the technology. Though such an analysis is useful it should not be seen as definitive. So much is unknown and unknowable before the implementation stages. Furthermore, what works in one location with one group may not work at another location with another group.

As indicated above, this research project involves a small number of students in one course of the University of South Australia. Though it is of significant value to even this small group, there is potentially a wide application at the institutional level.

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Using Desktop Publishing to produce Educational Materials: Hardware and Software Issues

Robert Goodwin

Desktop publishing software and hardware has made it possible to produce a range of educational materials that were previously only available via commercial printing processes. Professional looking student worksheets, overhead projector transparencies and instructional materials containing text and graphics can be quickly prepared and then updated as required. Until recently these materials could only be produced in black and white and it was difficult to incorporate graphics and photographs. New hardware and software developments are now making it economically feasible to produce some of these materials in colour and to include graphics and photographs at reasonable cost. In this paper I will look at the hardware and software available for desktop publishing and the types of educational materials that can be produced.

If Australia is to become the clever country it is important that education is able to compete successfully with all the other activities students can pursue. The availability of a wide range of attractively presented educational materials is essential to retain the interest of students. Educational materials, whether they be computer programs, videotapes, slides, overhead projector transparencies or worksheets need to be of a standard similar that the students see outside of education. Desktop publishing has made it possible for educators to produce professional quality printed materials for their students. These materials may be worksheets, notes, overhead projector transparencies or booklets. In this paper I will look at the software and hardware used in desktop publishing, the types of educational materials that can be produced and the new hardware and software becoming available.

Software

There is now a wide range of desktop publishing software programs on the market and some of the latest word processing packages incorporate many of the features of a good desktop publishing program. A typical desktop publishing system is likely to have the following:

- page layout and design software
- word processing software
- graphics software
- scanning software.

The page layout and design software must give WYSIWYG (What You See Is What You Get) presentation of documents and allow you to edit them in this mode. It must also be able to import text and graphics in the common file formats. The page layout and design software may contain word processing and graphics features but they are usually limited. (PageMaker 4 contains word processing but it is better to prepare text in a word processor first and import it as text is not lost if the PageMaker file becomes corrupt, a fairly common occurrence)

The word processing software should contain all the features needed for text editing, spell checking, thesaurus and grammar checking. The graphics package should contain all the tools you need and a vector graphics package is preferable as graphics can be scaled without loss of definition. Scanning software may be graphics only or have text and graphics capabilities. It is a great advantage if all of the software chosen will run in the Windows environment on DOS machines. The software actually chosen for desktop publishing will depend on what you want to do, the hardware you have available and what you can afford to buy.

The cost of the software is less of a problem these days as many of the more expensive commercial packages can be bought as educational versions for a greatly reduced price yet retain all the features of the commercial package.

If you do not want to do much with graphics other than incorporate an occasional scanned image or picture from a clip art collection a good word processor may be sufficient for your needs. If you want to produce detailed layouts containing text, graphics and tables then a page layout package is essential.

Hardware

As desktop publishing is graphics intensive it is important to select hardware capable of running the software at a speed that is not frustratingly slow. The minimum requirement for PageMaker 4 is a 386SX computer with 2 Mbytes of RAM. In reality such a machine is too slow for experienced users and a full 386 or 486 machine with 4 or more megabytes of memory is preferable. The screen needs to be of high quality and, for continuous use, an A3 screen is recommended.

Hard disk space is also critical. The software, particularly if using graphics and clip art libraries takes a lot of disk space. Forty megabytes is an absolute minimum and 120 or more megabytes is preferable.

A postscript laser or inkjet printer is essential for good quality printout although dot matrix printers give reasonable results when using the "true type" fonts available with Windows 3.1 or the fonts in Adobe Type Manager.

Scanners can be bought to enable text and graphics to be incorporated in documents. Scanners have improved considerably in the last two years.

Types of materials that can be produced with DTP

Student worksheets—Student worksheets containing both graphics and text can be prepared. Graphics can be annotated as appropriate and the worksheets updated as required.

Overhead Projector Transparencies—Desktop publishing programs give a wide choice of fonts and point sizes and graphics can be changed to appropriate sizes. Thus it is easy to produce overhead projector transparencies that can be clearly seen from any where in the room.

Booklets—Booklets, unit outlines and even whole books can be produced using desktop publishing. The in house control usually results in quicker production times as problems can be solved on the spot.

Wall Posters—Wall posters up to A3 size can be produced. They are usually easier to produce with a graphics package.

Recent Developments

A number of recent technological developments have opened new possibilities for the production of educational materials.

Digital Cameras—Obtaining photographs and incorporating them in desktop published material often presents problems. The recent release of the Logitech digital camera indicates that a reasonable solution to this problem may be available soon. The Logitech camera takes monochrome photographs that can be transferred from the camera to a computer via the communications port. Provided they are taken in good lighting conditions the photographs are acceptable for educational materials.

Colour Production—While the use of colour is not recommended for large blocks of text, as it makes the text difficult to read, colour can be used to highlight keywords. Colour can be very useful in graphics such as charts and diagrams. A range of recent developments has made the production of colour materials much easier. The use of colour is limited to "one–off" productions as there is no way at the moment of mass producing colour materials at reasonable cost except by using commercial printers. Colour production also presents storage problems as files containing colour graphics are usually too large for storage on floppy disks.

Colour printers—The colour inkjet printers now appearing on the market can be used to produce colour overhead projector transparencies and colour posters of A3 size at reasonable cost. While special paper is recommended for best results they give reasonable quality on standard paper.

Colour scanners—Colour scanners are now available for the same price as black and white scanners were a year ago. While good results can be obtained the colour files are very large, a relatively small photograph requiring ten or more megabytes of storage space.

Erasable Compact Disks—Storage problems may be solved using erasable compact disks. I have used the Sony system, which gives 600 megabytes of storage, for nearly two years.

The View from "Clever City": Looking at Australian education through promotional videotapes

Ian Hart
University of Hong Kong

The Australian Education Centre in Hong Kong has a library of over 150 videotapes on Australian schools, colleges and universities for reference by prospective students. Some have been produced by in-house educational technology units, the majority by professional consultants. This paper evaluates the effectiveness of these programs in the light of what we know about today's Hong Kong students and questions whether producers are pitching their programs at the right audience. The author goes on to suggest how educational technology units could more effectively assist overseas students in making a choice and preparing themselves for success in the the Australian university system.

Running out of luck

Australia in the 1960s and early 70s — Donald Horne's "Lucky Country" — was a place where it was easy to be complacent and to feel superior. We had defeated the Japanese in war and were the white master race of Asia envied for our British civilisation, our easy wealth, our high level of education. Asian students who came to our schools and universities under the Colombo Plan were our contribution to shouldering the white man's burden.

Then, in the mid 1970s things began to change for the Lucky Country: first, there was an economic boom in Asia which cut the already wobbly supports from under our protected industries and rapidly raised living standards in Japan, Hong Kong, Taiwan and Korea; then the bottom fell out of the export agriculture and minerals markets. Australia was left exposed as a country living in an illusion.

When, at the end of the 80s, Bob Hawke exhorted us to give up the dreams of the Lucky Country and become a "Clever Country", he probably had the city states of Hong Kong and Singapore in mind as models. These two economic "Mini-Dragons" have no mineral resources, no agriculture, no natural resources other than their people, yet their per capita foreign reserves are the highest in the world and their economies continue to grow in the face of a world recession.

Learning to be clever

Australia's future is in the Asian region and we can no longer afford the luxury of cultural isolation from the economic dragons to the north. We've made a start. We've set out to learn the secrets of the Clever Cities of Asia through Business Migration

Programs and by establishing off–shore trading companies and joint ventures in Mainland China. We're becoming involved in regional politics though ASEAN and UN initiatives in Cambodia and Vietnam. The Hong Kong Australian Chamber of Commerce is the one of the largest and most active in the territory. We're beginning to look smart ... if not exactly clever.

The change of emphasis in our dealings with Asia is nowhere more marked than in education. Australian schools, TAFE colleges, ELICOS centres, business colleges and universities are profiting from the increased wealth and heightened aspirations of Asian families by actively recruiting fee–paying overseas students who want a Western style English education.

The recruitment of overseas students has become an economic necessity at a time of cutbacks in financial resources. Some schools and universities have gone so far as hiring consultants and advertising agencies to promote their merits. Austrade has recognized the direct and indirect benefits to Australia of exporting education and organises regular Education Fairs in the major capitals of Asia where state education departments, independent schools and universities mount elaborate and impressive displays. And, in spite of adverse news stories on unemployment and the the economy and scandals over English Language colleges, Australia attracts 4–5000 Hong Kong students per year — the same as Britain, Canada and the USA.

Educational technology units have important roles to play in this process of educational entrepreneurialism:

- Through the production of information videos, brochures and computer programs.
- In providing multimedia materials to assist overseas students to settle into life on campus and to acquire English and study skills.

This paper surveys the a selection of current information videos being used for student recruitment in Hong Kong and attempts to assess their effectiveness in the light of what we know about the backgrounds and aspirations of Hong Kong students. It is by no means a guide to producing video material for Thailand, Korea, Taiwan or any other Asian country. One unfortunate blind spot which many Australians retain from the days of the Lucky Country is that there is one homogeneous Asian culture.

The "Typical Hong Kong Student"

15 years ago the "typical" Hong Kong university student was more likely to have been male than female, from a well–off middle class family where at least one parent had been to university, was in the top 5% academically and was fluent in English.

Over the past 10–15 years there has been a dramatic shift in the socio–economic profile of the Hong Kong undergraduate population. University study is no longer exclusively the province of the privileged élite and a first degree has become a prerequisite for any professional position.

Since 1981 there has been a 300+% increase in government funded undergraduate places. There are now seven degree–granting institutions in the territory. The current plan is for student numbers to increase by another 30% over the next three years.

Number of degree places (including undergraduate and postgraduate) provided by the UPGC-funded institutions:

1981/82	10,734	(full time equivalent)
1991/92	34,503	(full time equivalent)

Number of degree students graduated from UPGC-funded institutions:

1981/82	3,452	(head-count)
1991/92	9,009	(head-count)

TABLE 1: Comparison of Tertiary Places 1981/1991 [Source: University and Polytechnic Grants Commission]

The looming 1997 handover to China combined with the 1989 Tiananmen Square crackdown has also had an effect on the socio-economic mix of the student population. By some counts, as many as 60% of tertiary educated, middle class families have either emigrated to Britain, Canada, the USA and Australia or sent their children to be educated overseas as "insurance".

The effect of the overall increase in student numbers, combined with the wholesale emigration of an entire "class" has been considerable. Fifteen years ago at the University of Hong Kong, where English is the official language of instruction, 75% of students would have come from homes where at least one parent had been to university and English was the language spoken in the home. Today, 75% of students come from homes where neither parent has been to university, where Cantonese is the language of communication and where 50% of students do not have their own room or their own desk for study. [Source: University of Hong Kong Counselling Centre]

A profile of today's typical Hong Kong undergraduate population would show:

- Equally likely to be female as male
- 75% from "Sandwich class"[1] family background — neither parent had a university education
- Needs to work part-time to support studies
- Has difficulty communicating in English

What kind of students apply to study overseas?

Fifteen years ago if a student were not in the top 5% of school leavers the only opportunity to obtain a degree was to study overseas. Non-scholarship Hong Kong students studying in Australia were invariably from wealthy family backgrounds.

In more recent times, the signing of the Joint Declaration (on the handover of Hong Kong to China in 1997) has seen a rapid increase in applications for emigration from the Hong Kong middle class. Many parents who do not qualify under Business Immigration schemes believe that having children with overseas qualifications is important to their chances of successful emigration. An increasing number of these applicants are by no means privileged or wealthy (at least in Hong Kong terms) and are likely to have borrowed money to study overseas.

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[1] "Sandwich class" is a term used in the Hong Kong press to describe wage earners with incomes too high for public housing but not high enough to own their own homes or to receive "perks" such as housing, entertainment and overseas education allowances.

The profile of a "typical" Hong Kong applicant for an Australian university place would be very similar to the Hong Kong undergraduates described above.

Why choose Australia?

Applications for admission to Australian schools and universities are handled by the Australian Education Centre (28th Floor, Harbour Centre, Wanchai). The AEC is a self-funding organisation, part of the International Development Program of Australian Universities and Colleges (IDP), which provides counselling and information on the available options and assists with completion and submission of applications. The Centre caters to well over 100 potential students per day. It contains a library of information on contributing schools and universities, a computer data base on Australian education, over 150 videotapes and has eight counsellors who interview all applicants.

The principal reason applicants give for choosing to study in Australia is that relatives or friends live there or the family has an Australian visa and intends to move there after 1997. Comparatively few approach the Centre still undecided about choice of country to study in.

About 50% are applying to study overseas because they did not gain admission to the institution of choice in Hong Kong. (For students wanting an English language degree, the University of Hong Kong, with 12,000 undergraduate places in nine faculties, is the only choice in the territory.)

Future migration is less of an issue than it was five years ago. Most of today's applicants assume they will return to Hong Kong to work and seem reconciled to giving the Chinese take–over a chance. Opportunities for work in Hong Kong and in the Special Economic Zones are a lot more rosy than in Australia.

Who makes the decision?

The extended family remains a strong institution in Hong Kong and the support of family and experiences of relatives is obviously crucial in the decision to study overseas. However applicants rarely visit the AEC with parents and appear to make their own decisions about course and institution.

How do they choose the institution?

Most applicants for university places arrive at the AEC with a good idea of where they want to study, often from relatives or family members or friends who have studied there previously. Word of mouth is the most effective form of communication in parochial Hong Kong — a city of 6.5 million people but with a small town mentality. The most common reasons given for the choice are:

- *Reputation*. The older, established universities are well regarded in Hong Kong where many of the people in positions of power have degrees from the Universities of NSW, Melbourne and Adelaide; the claims of newer, ex–CAEs and amalgamated universities to equal status are regarded with scepticism.

- *International recognition of the award.* Hong Kong employers have strong views about the worth of degrees from different institutions and it is of little value stating that "our degrees are internationally recognized" if nobody in Hong Kong has met anyone with an MBA from Phar Lap University.
- *Financial.* The majority of today's applicants are not from wealthy families and have usually had to borrow money to study. Living with or near relatives is important, as is the possibility of finding part–time work.

What are they worried about?

Most applicants are well–informed about the geography, the economics and the political system. They know less about the Australian society and values. Australian news in the Hong Kong press tends to emphasise the parochial and the bizarre : the "Chinese" boat people lost in the North West, the election of Henry Tsang as Deputy Lord Mayor of Sydney, the murder of Dr Victor Chang, the fire bombing of Chinese restaurants in Perth.

Racial prejudice is an issue, as is organised crime in the form of Asian Triad gangs (a particular concern about Vancouver and San Francisco at the moment). but the major concerns of Chinese students today are no different to those of Australian students: financial and academic.

How are recruitment videos used?

The Hong Kong AEC screens a one–hour program of videos each afternoon: "Study in Australia", a general introduction which covers everything from high schools to post–graduate courses in a breathless 9 minutes (produced for the IDP by Broadcom in 1990) plus a number of institutional promotional videos. The catalogue of holdings is posted outside the screening room and visitors can request to see any program.

The screenings are not well attended. No students watch the videos in order to make a choice between Australia and some other country, or even between one university and another. On the whole, videos are used to reinforce the decision the students have already made and they sometimes invite parents or friends to come and look at where they will be studying.

The programs are also screened by visiting educational delegations to introduce their presentations. According to Stella Chan, Manager of the AEC, this tends to be a more effective use of the video.

The Sample

My plan for this study was to view all 150 programs held by the AEC but, after looking at 30, I could not bear to continue. It is an uninspiring collection: unimaginative, repetitious, poorly researched and seemingly more concerned with pandering to the egos of the university administration than with providing useful information to an audience of potential students. The commentary of one 9 min promotional video manages to list all 42 courses offered by the university (I counted), but the the only way the editor could achieve this feat was to cut our all the pauses for breath! Of the 30 programs I looked at, 21 were produced by outside consultants "for the University Information Office" (or equivalent), the remainder were produced by the university's educational technology units. In style, the programs fall into two basic categories:

- Hard sell of the Australian lifestyle and the virtues of the particular institution. Made in the corporate style, they begin with a map then show the compulsory 500 images of Australia in about 8–9 minutes accompanied by a non–stop, breathless recitation of clichés with little or no reference to the images ("Australia has long been recognized as...", "... a rich and diverse culture...", "... a balance of practical and theoretical skills...", "... but it's not all work..."); underpinned throughout by a music track chosen from the copyright cleared KPM collection by title ("Pastoral elegy", "Razzle–dazzle", "The road to nowhere"...).
- A day in the life of... a group of happy overseas students "here seen studying in the spacious and modern library of over 200,000 books"; here sitting in on a stimulating accountancy tutorial; now choosing from the "mouth–watering range of nutritious and multi–cultural food" in the student canteen; now sharing a weekend barbecue with a veritable stock–shot library of native animals and a parade of awkward and embarrassed host families; and finally, dancing the night away in the sophisticated discos of the neon–lit metropolis...

I may appear to be being harsh and cynical, but the experience of sitting through 30 of these programs generated a mental state where I would willingly have shotgun blasted the screen the next time a surf boat turned turtle, a sheep dog hypnotised a ewe, or a grimacing Asian beauty cuddled a koala. Hypocritical I am not, having been guilty of producing more than my fair share of such programs in the past.

Apart from the excess of cliché and repetition, (and, after all, how many students are going to watch more than one or two anyway?) it is clear that many of these programs are being made for the wrong audience and carry messages about Australia which reinforce unfortunate stereotypes.

They are not all bad. The most popular program screening at the AEC is not about education at all. "Bridging the Gap" was produced specifically for a Hong Kong audience by the Information Office of the Australian High Commission to encourage business migration. It is simply a linked series of interviews with successful Chinese who have made it in Australia: Alderman Henry Tsang, parliamentarian Helen Sham Ho, actor Jackie Chan, Vice Chancellor Wang Gungwu and his wife, plus restauranteurs, estate agents, herbalists and business people. The program is parochial, comprehensible and very simple in structure. Watch the audience as they view it after one of the Australian propaganda videos — their expressions change from polite puzzlement to wide smiles.

Some Production Guide–Lines

The potential producer of promotional videos for a Hong Kong audience should bear the following points in mind:

- *Language*: Most of of your viewers will not have a sophisticated understanding of English. Consider making a Cantonese version. If you must use an English narration, keep the language simple and space it out.
- *Content*: Your audience does not need to be convinced to study in Australia or even at your university — they have already made their choice and now want positive reinforcement that their decision was the right one. Hong Kong students are unlikely to be impressed by shots of cosmopolitan high life or Australian crowds — they have enough of their own — they want to see the university's teaching and

study facilities, where they will be living, places they might find part–time work. They would particularly be interested to see interviews with present Hong Kong students, talking about their experiences.

- *Taboos*: Hong Kong is a conservative, even prudish society, with strong family values. Shots of gambling casinos, topless beaches, two–backed beasts on the quadrangle lawn and Muck–Up Day drinking binges are not strong selling points. (Even less so, I would guess, for applicants from strict Moslem countries!)

Post–Arrival Problems

One of the first shocks to a Hong Kong student coming to Australia to study is the possibility of failure. At Hong Kong universities, once a student has been accepted, there is an expectation that he/she will graduate at the end of the course. The first year leaves a lot of time for social activities and, although the work becomes more difficult towards the end of the course, very few students fail. By contrast, attending an Australian university where first year drop–out rates in subjects like Accountancy and Economics can be has high as 60% is extremely stressful.

Most universities taking overseas students either provide or recommend an introductory ELICOS course to ensure that the student's English is adequate for understanding lectures. Some even provide special counselling services and support groups for overseas students. Remedial English is of course necessary for many students, but a "satisfactory" score on an English test is no guarantee of success at university study.

Many Asian students come to Australian universities from an educational culture which lays stress on modelling and learning by rote rather than on academic argument and enquiry. It is not until one has mastered the known facts that one is qualified to offer an opinion. They see themselves as "observers and reporters not as participants" (Allison, 1991) and the idea of putting forward their own ideas in a seminar, let alone disputing the case with a teacher, is alien, not to say extremely rude.

For students used to working from a single textbook or reproducing the words of a teacher, the idea of going back to original sources and weighing the opinions of one authority against another is also unfamiliar, even threatening.

At the University of Hong Kong the problem of introducing students to a Western academic environment has been exacerbated in recent years by the changes in the composition of the student population I described above. English is no longer the language of communication outside the lecture room and in some faculties seminars take place in a mixture of Cantonese and English. The university has recently set up an English Enhancement Centre with the aim of improving the academic communication skills of undergraduates. Educational technology is playing a large part in this initiative with much use being made of video and interactive video and computer based materials in both classrooms teaching and self–access centres. The aim being to increase interactivity and transform students from passive listeners into active participants.

We are late starters in this area, a long way behind the two polytechnics. The City Polytechnic, with the advantage of a newly built campus, wired for centralised computer and audiovisual delivery, a micro on every lecturer's desk and a planned ratio of one microcomputer to every four students, is making impressive use of the computer network for instructional delivery, assignment submission, marking and feedback, with the objective of increasing interactivity. Jonathan Marsh has described the strategies in detail in a recent paper for the Hong Kong AECT (Marsh, 1992).

Conclusions

The educational technology centre has an important role to play in the recruitment and assimilation of overseas students. This paper has described some of the characteristics of Hong Kong students and indicated a few of the less successful attempts to communicate with them.

Successful communication involves understanding the audience. Too few producers of these programs have asked the question "How will it play in Preoria?" or Seoul, or Bangkok or Hong Kong... seeming more intent on designing their programs for the ego of the sponsor. Programs produced by university educational technology units, though lacking the technical sophistication of commercial products, are often more informative and successful.

For the overseas student already on campus, educational technology materials can be a valuable source of information and enlightenment as well as means to developing good sudy skills. Media Centres can assist by working closely with other professionals in ELICOS, Counselling and Study Skills centres, as well as with the students themselves (eg. through Overseas Students Associations); to produce programs, to make materials readily available and to come to know and respect the audience.

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The Distance Education Learner and Educational Technology

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The use of educational technology, particularly, in distance education, requires a theoretical underpinning to define its role in reducing power asymmetries and fostering deep learning. This paper explores the reciprocal nature of learning and teaching as a basis for interpersonal interaction in technology media. Hence, to promote an interactive learning environment, the concept of the **educational feedback loop** advances equity of communication and mutually empowers both learners and teachers to exchange and explore ideas as partners.

The emergence of the learner in distance education is bound to one of the earliest forms of educational technology — the letter as a medium of communication. Applying this new technology to involve learners at a distance in an on-going discourse about their faith, the apostle Paul conducted educational correspondence throughout the Roman Empire of the first century (Ortner, 1991). This historical precedent and its contemporary counterpart in email, computer based tutorials, and teleconferencing underscores the strong links between distance education learning and educational technology. With respect to these collaborative links this paper considers the importance of involving the distance education 'learner' in an *educational feedback loop* whose medium is educational technology and whose aim is the the empowerment of the learner as a reflective practitioner (Boles & Davenport, 1975; Garrison, 1989; Verduin &Clark, 1991). The paper first considers the basis of this empowerment—the reciprocal nature of learning and teaching, especially in distance education.

The reciprocal nature of learning and teaching

In teaching, the transfer of knowledge between 'teacher' and 'learner' is not unilateral. Traditionally, whenever education has valued dialogue, learning and teaching have been chiefly reciprocal activities; the learner taught and disseminated what he or she had learned, and the teacher learned from the discourse with those whom he or she taught (Eble, 1988; Ramsden, 1992). This mode of information transfer and knowledge acquisition forms an integral part of learning and teaching interaction. Hence the fluid alternation of roles, whereby the learner teaches and the teacher learns, provides an historical precedent—be it through letters of correspondence or discourse engendered by the printed word—for the development of a circuit of educational feedback in concert with educational technology. Yet the use of current and future technology requires a theoretical underpinning in the reciprocal nature of learning and teaching if high-technology media are not to become a means merely of facilitating the speed and volume of communication while neglecting the striving towards equality of communication.

The Reduction of Asymmetry

The reciprocality of learning and teaching is also a constituent factor in reducing the asymmetries of power between the conventional authority of the teacher as lecturer or tutor and the dependence of the learner as student. Although varying degrees of asymmetry will persist in the authority to assess students' comprehension and application of instructional materials, the process of fostering greater symmetry in educational discourse is also a process of mutual empowerment. The empowerment of the learner and teacher challenges the hegemony of the status quo and the conventionally distinct roles of those who teach and those who are to learn. If the dialogue model of distance education (Holmberg, 1991), with its asymmetries of power between instructor and student, is to complement the industrialised model (Peters, 1991) and its emphasis on access and equity, then the issue of social justice needs to be addressed in the interplay of distance learning and teaching with educational technology. For this purpose, the educational feedback loop as a theoretical construct and practical nexus between learner and teacher offers a means to heighten the symmetry of "Instructional transfer" (Brooks & Dansereau, 1987). This circuit of on-going feedback also generates a momentum designed to reduce traditional power relationships that rest upon the clinical distinction between the 'learner' and the 'teacher.' Crucial to the deconstruction of this distinction—to mutual empowerment of 'learning' teachers and 'teaching' learners—is the degree of purposeful involvement of all parties in the circuit.

The Meaning of Involvement in Educational Technology

What makes an educational interest in new technologies more than an infatuation—a romance lacking often a sound theoretical base in learning and teaching? Or posing the question differently, how can the distortion of educational technology as chiefly a facilitator of speed and volume be overcome? The answer lies not only in maintaining a focus on the reciprocality of learning and teaching, but also in maintaining a sense of involvement in technologically based activities as a medium of human interaction, discourse, and self-realisation. It is this sense of involvement in technology that contributes to its humanisation and educational usefulness. The application of computer based learning, for example, allows participants in a feedback loop to highlight different aspects of the learning process. Gennaro Pellone, looking at learning theories and computers in TAFE education, comments (Pellone, 1991, p. 45):

> Many theories exist which try to explain the process of learning. Each, more than others, tends to emphasize certain aspects of the teaching-learning process. The flexible facilities of the computer enable us to focus on selected aspects of learning theories and implement teaching strategies that would be difficult to realize by other means.

Irrespective of the learning theories involved—whether they are the "Approach to Learning" concept (Ramsden, 1992), behavourial, cognitive, cybernetic, or developmental theories—all can advance interaction (Pellone, 1991). The learner/teacher can also choose to highlight more than one aspect simultaneously. She or he may, for example, achieve a mix by combining a cybernetic view, cybernetics being "the science of control and communication" (Simons, 1985), with the "approach to learning" concept to affect a 'self-controlling' system for deep, holistic learning. Hence the levels of involvement may be many and varied. A 'self-controlling' system of learning can enable participants within an educational feedback loop to attain more symmetrical interaction and equity in communication, as well as a deeper involvement with the subject area through personalisation by relating the area and learning materials to their own lives, experiences and goals.

Deep and Surface Learning /Interaction vs Lack of Interaction

On the one hand, the student in deep learning "maintains structure of task … has intention to understand (and) focuses on what the task is about … relating theoretical ideas to everyday experience" (Ramsden, 1992). On the other, the student in surface learning "distorts structure of task … (and has) intention only to complete task requirements" (Ramsden, 1992). Yet there are both group and individual factors which can determine how a student approaches learning, ie, whether she or he prefers deep or surface learning. N.J. Entwistle comments on students' perceptions: "… it is students' perceptions of the learning environment that influence how a student learns, not necessarily the context in itself" (Entwistle, 1987). These perceptions create patterns of inter-relationships among students—"study orchestrations" (Meyer and Müller, 1990; Entwistle, 1991) which serve either to encourage or undermine deep learning. Accordingly, as educational technology involves the learner/teacher more and more in mutually beneficial inter-relationships with others and in interactions with the subject area and content, it promotes a positive perception of computer mediated learning as a means of deep learning.

Conclusion

This paper has considered the distance learner with regard to the reciprocal nature of learning and teaching in educational technology. In the transfer of knowledge via email, particularly within computer based tutorials, or by way of audio-teleconferencing, educational technology can enable the distance learner to establish and take part in an educational feedback loop—a circuit designed to advance equity of communication and mutually empower both the learning teacher and the teaching learner to exchange and explore ideas as partners. This paper further considered the crucial issue of educational technology as a means of involving the distance education learner in supportive inter-relationships within a given feedback loop. Hence the perception of the 'learning environment' as condusive to interaction "between student and context" promotes deep learning.

It is likely that educational technology in its current and future manifestations can continue to act as a humanising agent in distance education, whereby as reflective practitioners learners will remain free to teach and teachers willing to learn.

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Open learning and telecourses: The role of television in adult education in Australia

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The role of television as a resource for open learning and distance education has been placed on the national agenda with the apparent success of the *TV Open Learning* project. This paper examines the project within a historical context and compares it with the much larger proposed *Open Learning Initiative*. The inter-relationships of governments, universities, video producers and broadcasters in the current project will be compared with previous efforts for adult education via television. This paper also considers some of the broader issues that *TV Open Learning* raises. How is "open learning" to be defined in the Australian context.? For whom should this service be provided and how should it be funded? The paper analyses the major differences between TVOL and OLI and suggests some likely policy outcomes for the future.

In search of "openness"

The term "open learning" has been appropriated by the Federal Department of Employment Education and Training (DEET) to describe the pilot educational project: Television Open Learning (TVOL). It has also been used, for a larger proposal by DEET, called the "Open Learning Initiative" (OLI). The actual meaning of "open learning " as it is used in these projects is complex. Although the term has been frequently used to describe the nature of education offered by various organisations, open learning is a term that defies precise definition.

Rumble (1989) suggests that there has been a monstrous misuse of language to describe some projects as "open learning" which are in reality "closed" in their approach. The terms open learning and distance learning have come to be used by some people as if they were synonymous. He emphasises that "open learning" techniques are not the exclusive preserve of distance education and can, also, be used to deliver courses for on-campus education. Rumble provides a taxonomy of characteristics that have been applied to "open learning" These include criteria of access, freedom from the constraints of time and place, alternative presentation options, flexible assessment and support services. Rumble (1989,p35)

How "open" is TVOL?

TV Open Learning is built around the broadcast by the ABC of television programs which provide the initial resource for the learners. The system is "open" in the sense that anyone can tune in and it costs nothing to watch the programs. Students only pay if they want to purchase written resource materials or enrol to do examinations that lead to course credit. If we apply the range of criteria for "openness" identified by Rumble then the present project displays many, but not all, of the characteristics of "openness".

1 Access criteria

Access objectives were a key part of the rationale for the TVOL project. It was intended to "extend access to those in the community, who, for reason of isolation, or family or work responsibilities were unable to attend on-campus courses" (TVOL Background Paper No 2). Three levels of student participation were allowed: watching the television programs only; purchasing the study materials; and completing assessment tasks to gain credit for the subject.

2 Place and pace of study criteria

In this regard, TVOL allows students to study at home but the pace is less flexible than some other projects. The pace is regimented, to some extent, by the once a week telecasts of the subject video. This compares with other distance education courses where the individual can work through non- broadcast video or audio materials at their own pace or rely entirely on written material.

3 Alternative presentation criteria

The TVOL project displays some flexibility, for learners, in their decision about what media to use to assist their learning. For each unit there is a study guide, readings and broadcast notes. Just how interdependent these materials are, is hard to judge. The "instructional" style of different TV programs varies. Some stand alone while others need the written supplements to be fully understood.

4 Assessment criteria.

Rumble includes the learner's ability to negotiate the method of assessment in determining "openness". In these terms TVOL is relatively closed. The student prospectus emphasises that the students must register for assessment in the study period in which the unit is offered or when the unit is repeated. There are only two exam periods per year. This apparent inflexibility is an obvious part of a desire for TVOL to be seen as equivalent to similar university subjects and a practical consequence of a short-term pilot project.

5 Support services criteria.

Each of the Universities providing subjects for TVOL provide quite varied support services. They include telephone tuition for a fee and some other hot lines to assist students. The group tutorials used in the British Open University are not a major part of TVOL in its pilot form.

Adult Education and the ABC

Direct curriculum related support for adult education has not been a feature of ABC television programming until recently. There are many reasons for the ABCs late entry into this area. They include funding, absence of charter responsibility for adult education, institutional conservatism, and a fear that any move into adult education would be at the expense of school broadcasts (Ramsay 1988). With just one TV channel (unlike the BBC) the ABC has been constrained about broadcasting in this area. The recommendations of various committee's has supported this. In 1974, a committee investigating whether a British Open University model was appropriate for Australia warned that it would be virtually impossible for the ABC to use its limited airtime for an Open University/BBC style project. The committee felt the ABC would have little time left to provide programs for a general audience, Karmel (1974 p91) A sub-committee of the ABC Federal Broadcasts Advisory Committee joined others in 1979 in calling for adult education via an additional ABC television channel, Gilmour (1979 p71).The advent of SBS, the additional public service channel, provided for the multicultural needs of adults but not specifically adult education.

Another reason is the diversity of the adult education audience. The schools audience, by contrast, is a large and visible client for the ABC. The audience for the program Behind the News is estimated as more than one million children.(Palmer & Black, 1987) The adult education audience is less well defined and is serviced by a wider range of curricula and providers.

In areas of specific need in adult education, programs have been produced when outside money has been available. In 1987, Learning Network Pty Ltd, an outside commercial company, proposed to use the ABC and SBS early morning time-slots to deliver "telecourse" material. Individuals and educational institutions would pay a licence fee to record and use these materials. The project faltered in 1988 because of, lack of Australian produced material and under-funding, public sector resentment to a private sector initiative, competition from educational institutions with their own TV production facilities and Federal budget cuts to the States (Widdowson, 1990, p165)

Adult literacy was the next move by the ABC. The "Fresh Start " series was broadcast in 1990 with outside funds as a consequence of the International Year of Literacy, (Perlgut, 1991). This project has been extended in 1992 to become the "National Television Literacy " series. It is planned for day-time transmission in August 1993. The objectives of the new series are to provide practical instruction in literacy and numeracy and to inspire potential students to make the first step towards formal classes, (Outline of the proposed series July 1992).

TV Open Learning

The funding of TVOL was announced as part of the 1990-91 budget statement. The Commonwealth Government decided in advance that television and independent learning materials was an appropriate means of improving access to higher education. DEET asked for universities and broadcasters to tender for some two million dollars to set up a project to extend access to higher education. This tender process is part of the current "economic rationalist" approach of consortiums of educational institutions competing like commercial companies for offerings from Canberra. A consortium of five Universities led by Monash University with the ABC as the host broadcaster won the tender. The other universities were: University of New England, Griffith, University of South Australia and Deakin University.

The lack of entry requirements for TVOL is the most obvious difference for students of TV Open Learning compared to students of traditional on-campus education. There are no educational prerequisites, no higher education scheme fees, no quotas and no age limits for TVOL.

The TVOL project was to have been conducted on a small scale and used to evaluate the potential of educational television to improve access to higher education and promote open learning. In fact before the independent evaluation of TVOL is even complete, the Minister for Higher Education, is proposing to go ahead with a much larger project. Submissions have been called for the Open Learning Initiative (OLI). The perceived success of TVOL has been used as a reason for the OLI to be developed. Just how can we measure the success of TVOL which has only been going for six months.

Independent evaluation of TV Open Learning

The independent evaluation of TV Open Learning Project started in January 1992. The team from the University of Sydney, School of Educational Psychology, Measurement and Technology is directed by Associate Professor Bruce Keepes and is quite independent from the TVOL consortium. Their work is on-going with the interim evaluation report submitted to DEET in April and some additional survey information available in August.

Some possible measures of " success" are implicit in a lot of the data from the interim report. One indicator is the response by people wanting to become students. An astounding 38,657 people rang a 0055 number to inquire about TVOL. Some 3,762 people purchased study material for the five programs telecast during the first study period This was some ten times the market research estimate for the units of 400 people. Each of those people who purchased materials were asked to fill out a questionnaire. Their responses have been analysed as part of the TVOL Interim Evaluation Report

An increase in access to higher education was a key objective set by DEET for TVOL. The interim report concludes

> the project has provided equity and access to higher education for many who, because of isolation, work or family commitments, did not previously have such access. For these students, TVOL is seen as an alternative to conventional distance education and on-campus study. (Keepes, 1992, p16).

However some specific results of the survey indicate some of the assumptions implicit in the rational for the Open Learning Initiative may be faulty.

1 Unmet demand.

The students enrolled in units in TVOL were not predominantly students who had missed out on a place at university (unmet demand). Some 12 % of TVOL participants had applied for a place a university and were not accepted. Numbers in individual units were higher with the most in the marketing subject (21.8%.) Some 42% of the total sample already had a degree or diploma from a University or CAE so they were not school leavers seeking a place at university.

2 Reasons to study through TVOL.

The vast majority of students lived within a catchment area for a university and could have theoretically attended a university. The main reasons given for studying through TVOL were interest in the subject, to refresh knowledge, work commitments, time factors, flexible and easier to study at home and to broaden the mind. These reasons accounted for more than 75% of the responses.

3 Broadcast times and videotaping.

Some 80% of the respondents video taped the programs. The vast majority of respondents "strongly agreed" that TV was a good supplement to the print materials. The results of a follow up questionnaire has given data on the progress of students. The most recent information on the units in Marketing, Australian Studies and Religious studies indicates a potentially high completion rate. An average of 80% said they would complete all the segments of the subject. Nearly half of those students said they planned to undertake assessment for the units they were studying. Unlike on-campus education students in TVOL could decide whether to complete assessment or merely purchase the study materials and leave it at that. If they wanted to be assessed this was an additional charge and included an examination and other assessment tasks. Many students may actually complete the unit but choose not to be assessed. The pass/fail rates for those who have undertaken the exams are not yet available.

The question of whether these students would want to do their whole degree through TVOL presents a split with more saying yes, they would, but a large group of the others saying it was unlikely.

The main insights we gain from these two surveys are that the population of students in TVOL is different from the population in Universities, that television is perceived as an important component of the process and that although they could theoretically have attended University to complete these subjects, most have chosen not to. One interesting exception is a student in the Northern Territory who is studying marketing through the University and TVOL simultaneously. The diversity of the students is remarkable with "French in Action" attracting the youngest student, a 13 year old girl, and the oldest, a 72 year old man.

The Open Learning Initiative.

The Open Learning Initiative has been justified, in the main, on the basis of the success of TVOL. The two projects have many features in common but there are also some key differences between them. The OLI is aimed to alleviate unmet demand in a much more direct way than TVOL. This is a response to the record shortfall of university places by nearly 50,000 for 1992.

TVOL has attracted a lot of publicity and been favourably reviewed by academics and commentators. The Open Learning Initiative has been less well received. The Vice Chancellor of Griffith University, Professor Roy Webb is reported to have said that "brokering Open Learning nationally was really a way of introducing full fee-paying students while possibly watering down standards" (Australian 22/7/92:13) The Australian Vice Chancellors Committee also has expressed fears that the plan might threaten the quality of university education and create a "second class of smorgasbord degrees." (SMH, 17/7/92, p 11)

A de facto tender process has already begun for the OLI with "expressions of interest" from universities and broadcasters due on 7th August, 1992. The briefing document indicates some of the expanded features of the OLI compared to TVOL.

1 Access

This is still crucial but the specific target groups (mature age students, isolated people at home) have been removed and replaced by a more market-led target for subjects in high demand. The TVOL project was heavily subsidised by the Commonwealth government with only token financial contribution from the students, the universities and the ABC. The proposed OLI works quite differently and is meant to be self-funding by 1995.

2. Place and pace of study criteria

The OLI is planned to provide up to a whole degree by open learning. In this regard OLI seems to be moving towards the re-organisation of Distance Education Centres under the effective control of "an independent organisation." This new organisation would act as a broker between the students and the education providers. This change is quite possible because the present Distance Education Centres have no promise of funding after 1995. The benefits for students of OLI, according to DEET, are in the increased flexibility and innovation in the provision of high quality tertiary education services.

3 Alternative presentation criteria.

The OLI will have a range of delivery modes. These will include computer assisted learning, audio and video materials, and radio and television broadcasting. The DEET information also instructs potential providers that "the proposal will need to demonstrate that the educational benefits of the technologies applied are commensurate with the costs." (DEET, 1992, p2)

4 Assessment criteria.

The assessment techniques to be used are left up to the broker in co-operation with the education providers. There is a specific reference to the question of quality and standards. The broker is to institute quality assurance mechanisms to ensure "parity of esteem" between open learning courses, assessments and awards and those available through existing arrangements. This idea of "parity of esteem" seems ambitious in the university sector where differences in" esteem" between courses and institutions have been a persistent feature. "Esteem " is a difficult thing to measure and will vary on quite subjective criteria from course to course whether it is open learning, distance education or contiguous education.

5 Support services criteria.

Under the proposed OLI project students could expect in return for their fees: access to library services, assessment including examinations, an advisory service to help them plan their program of study, appropriate credit transfer and the ubiquitous menu of purchase options. However DEET suggests that students will have to pay extra for some support services. The extent and cost of support for students is not clear. Is any "free" contact allowed with tutors or is it all an extra charge?

The whole document and the thrust of OLI vacillates between a private enterprise/user pays model and access and equity/open learning model. These two models are, in many ways, incompatible. The market forces /user pays approach would seek to recoup costs and make profits by requiring students to pay for everything. The access and equity/open learning approach seeks to encourage flexibility and even subsidise students. The project is meant to be self funding by 1995. Yet a number of clauses in the proposal call for flexible and optional payment structures, minimisation of hardware costs for students and a limit of $2,400 on the fees charged per year.

The project also has another set of agendas with the additional optional requirement for the broker to provide services beyond the university sector and for educational export.

The Future

The diversity and commitment of people to TVOL indicates a needs and a market for this style of higher education. The Open Learning Initiative moves towards a much larger degree program. It is immersed in the issue of the administration of Distance Education Centres and the perceived political imperative to provide more university places cheaply and fast. It may well work but there are a whole range of technological options that can also be considered for the future. Pay television, narrow-casting, compressed video, optical fibre links, satellite networks to factories, colleges and universities. The selection of these technologies should be carefully made in the light of needs, costs and benefits and sound principles of adult education and instructional design (Hedberg, 1989).

The fate of the Open Learning Initiative may well be determined by the outcome of the forthcoming Federal election. Some observers see OLI as a desperate measure by the Australian Labor Party to win votes and capture the potential disaffected student and mature age voters who can not get a place at a university. The self-funding aspects of the proposal may also be attractive to the Liberal/National party if they win office. Creative national use of educational television for adult education has, I believe, been established by the success of TVOL. The reason it has taken so long to get this in Australia is the need to have an union of purpose between the three parties of government, universities and a broadcaster. Previous attempts have failed to gain this tripartite support.

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